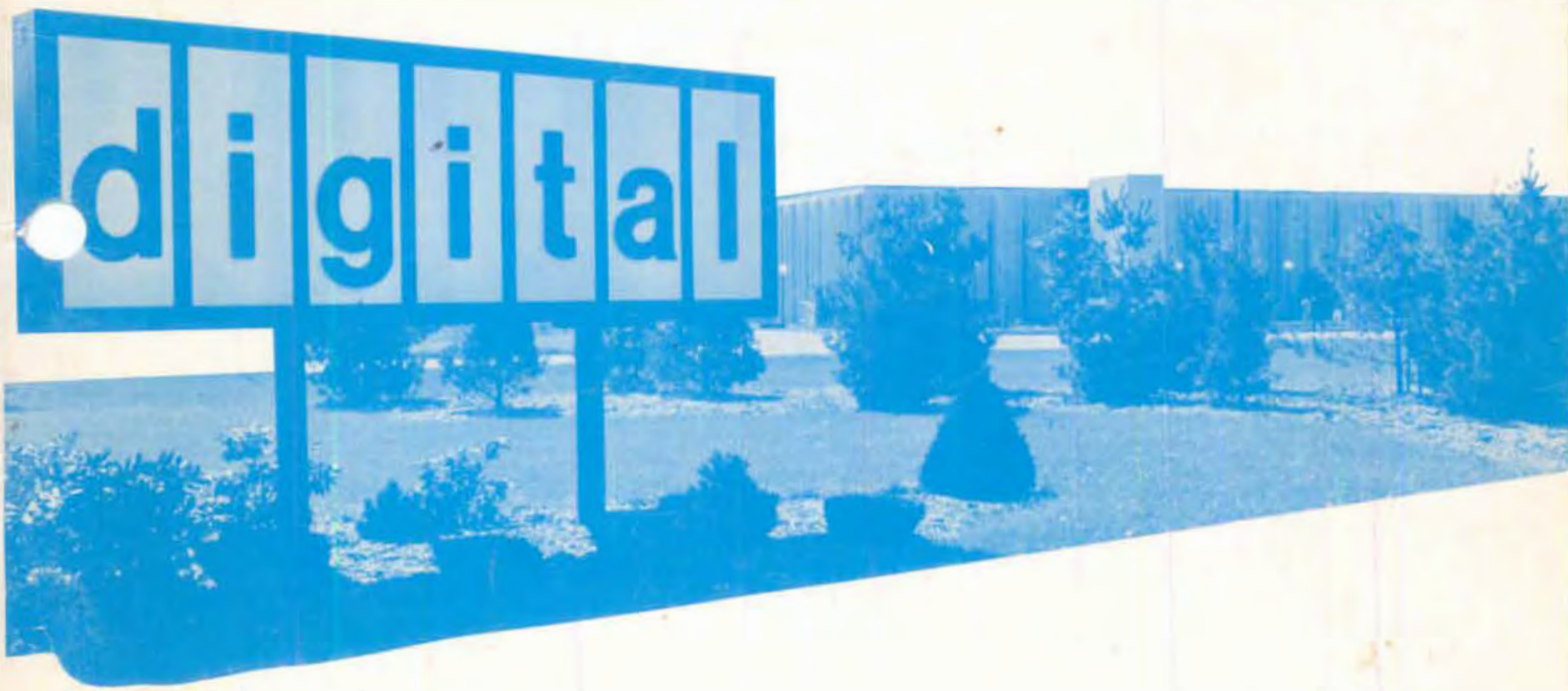
DIGITAL EQUIPMENT CORPORATION

NINETEEN FIFTY-SEVEN TO THE PRESENT



DIGITAL EQUIPMENT CORPORATION

NINETEEN FIFTY-SEVEN TO THE PRESENT

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DIGITAL EQUIPMENT CORPORATION
MAYNARD, MASSACHUSETTS

Thompson St. --- Assabet Mills. 1881

INTRODUCTION

Digital Equipment Corporation is proud of its history. In a relatively short period of time, DIGITAL has grown into the leading manufacturer of minicomputers. However, our growth in size and volume has not diminished our feeling of responsibility to furnish our customers with the highest quality products and service that we can provide.

It is fitting that DIGITAL had its beginnings in an old New England mill. The mills of this region have always stood as examples of New England's traditional values: the work ethic, Yankee ingenuity, care in craftsmanship, and pride in good work. However, these values alone are not sufficient to sustain a successful business. DIGITAL has incorporated these traditional values and successfully added innovative and dynamic approaches to the computer field.

This document does not assume to be a total history of Digital Equipment Corporation, for DIGITAL's history is not yet complete. We are constantly creating new ways in which our products, services, and computers may serve and fulfill the needs of our customers.

GENERAL
MAYNARD MILL
DECUS

HARDWARE
MODULES
MEMORY TEST
PDP-1
PDP-2, PDP-3
PDP-4
PDP-5

FINANCIAL SUMMARY

1957-1963

GENERAL 1957

Nineteen seventy-seven marked the 20th anniversary of the founding of Digital Equipment Corporation. On August 23, 1957, three men, Ken Olsen, his brother Stan Olsen, and Harland Anderson began DIGITAL with $70,000 of capital, 8,500 square feet of rented space, and a single product—logic modules.

Today, DIGITAL has more than 90,000 computer systems in operation, is the largest manufacturer of interactive minicomputers, and is a billion dollar-a-year company. DIGITAL is the sole owner and occupant of the sprawling 21-building Maynard Mill complex and has expanded operations to an additional 300 sites throughout the world.

In early 1957, Ken Olsen, Stan Olsen, and Harland Anderson left M.I.T.'s Lincoln Labs, where Ken had worked with some of the first transistorized computers, the TX0 and the TX2, machines that were also revolutionary in having core memories. Although many manufacturers already existed in the field, none had a firm control of the market. The three men decided to set up a company primarily to sell electronic modules for fast (5 megacycles) applications, applying the solid state techniques they had learned.

MAYNARD MILL

They first rented 8,500 sq. ft. of space, now Building 12, in the Maynard Mill complex. The company was set up with funding from American Research and Development, a Boston-based, venture capital firm. AR&D bought 70% of the company for a $70,000 initial investment.

1961

DECUS

DECUS, the Digital Equipment Computers Users Society, was founded for users of DEC computers and modules. This group has grown to become the largest single computer users society in the world.

HARDWARE 1958

MODULES

The initial applications of DIGITAL's modules were in testing (memory systems, etc.) and other laboratory automation operations.

A second range of modules which allowed more components on each board was announced. These "system modules" were actively sold until 1966 and in various forms were the basis of five subsequent computer systems.

1959

MEMORY TEST

Early in the year, the company designed a system for use in the memory test area. Around 50 memory testers were sold in the eight years DIGITAL remained in the market.

PDP-1

Around this time, the company's first Programmed Data Processor, the PDP-1 computer, was being designed. It used DIGITAL's own system modules, which came from the existing range of 10MC logic released in late 1959. The first PDP-1, delivered in December, was a high speed, 18-bit, small computer capable of addressing 32K of core memory. An average configuration cost $120,000 in an era when most computer systems were sold for a million dollars or more.

Some of the first PDP-1's had graphic display systems as peripherals. These were the first commercially available graphic terminals for computers. Although the last PDP-1 was built in 1969, nearly all 53 PDP-1's are still in use, most of them in universities. Some of the applications of this machine included message switching, instrument control, and special purpose timesharing.

PDP-2 AND PDP-3

Two new products, the PDP-2 and PDP-3, were proposed while the PDP-1 was in production. The PDP-2 never progressed beyond the initial stages. The PDP-3, a 36-bit computer based on PDP-1 concepts, was designed but not built by the company.

1962

PDP-4

The PDP-4, first delivered this year, began a development tradition. Although similar in structure (18 bits but slightly different architecture) to its predecessor, the PDP-1, it was considerably less expensive. The use of slower memory and different packaging allowed the company to reduce the price to $65K.

Approximately 54 PDP-4's were sold in application areas as diverse as nuclear physics, production, and stock control.

1963

PDP-5

The PDP-5, DIGITAL's first 12-bit computer and the world's first commercially produced minicomputer, was designed for a market that required much less computing power than was presently provided by machines like the PDP-4, but that had applications needing solutions too complicated to be solved efficiently by modules systems. The success of the PDP-5, forerunner of the PDP-8, proved that a market for minicomputers did exist.

FINANCIAL SUMMARY

FISCAL YEARS	1962	1963
Total Operating Revenues	$ 6,535,502	$ 9,906,968
Income Before Income Taxes	1,667,180	2,399,104
U.S. & Foreign Income Taxes	860,000	1,218,907
Net Income	807,180	1,180,197
Total Assets	4,177,363	4,835,580
Current Assets	3,845,375	4,248,646
Current Liabilities	2,598,247	1,803,866
Stockholders Equity	1,492,241	2,661,089
No. of Shares Outstanding at Year End	22,162,500	22,792,500
Net Income Per Share	$.04	$.05

GENERAL
FIRST PRODUCT LINE

HARDWARE
PDP-6
PDP-7, PDP-7A
FIRST MINICOMPUTER
PDP-8
PDP-8S
PDP-9, 9/L
LINC-8
PDP-10

FINANCIAL SUMMARY

1964-1967

GENERAL 1964

FIRST PRODUCT LINE

The first Product Line at DIGITAL was formed during this year, an event that marked an upswing in DIGITAL's sales volume and profits. This approach teamed the Engineering, Programming, Marketing, and Production departments under a Product Line Manager who had profit and loss responsibility. The concept soon spread from the PDP-6 group to embrace the entire company by the following year.

HARDWARE 1964

PDP-6

The 36-bit PDP-6, DIGITAL's first large computer, was released late this year. It was the first commercially available computer with manufacturer-provided software for general purpose timesharing applications. Other timesharing systems, such as the PDP-1 and Project MAC at M.I.T., were previously available, but none had manufacturer support. Some new techniques, including larger system units, were used in the twenty-three PDP-6 systems installed.

PDP-7, PDP-7A

The PDP-7 was added to the range of 18-bit computers. This successor to the PDP-4, using the smaller, more conventional system units, was well received in laboratory and data acquisition applications.

A second version of this machine, known as the PDP-7A, was built about a year later using R Series modules.

One hundred-twenty PDP-7's were sold all together.

1965

FIRST MINICOMPUTER

The highlight of 1965 was the introduction of the first production model "minicomputer" (small in physical size; word-length under 16 bits; selling in minimum configuration for under $20K).

PDP-8

This computer was the PDP-8, or classic 8, which used the newly announced R Series logic, and of which more systems in a variety of configurations and for innumerable applications have been sold than any other DIGITAL product.

Just prior to the 8's announcement, both major competitors had introduced competitive machines based on the price and performance of the PDP-5, giving the PDP-8 a two-year edge in the marketplace.

1966

PDP-8/S

Following upon the success of the PDP-8, a serial version, called the 8/S, was developed. This design took only nine months from inception to production, underlining DIGITAL's record of production engineering. The PDP-8/S was the first computer with 4K of memory sold for under $10,000.

PDP-9, PDP-9/L

Also during this year, the PDP-9 was added to DIGITAL's line of 18-bit computers, featuring a speed increase of approximately twice that of the PDP-7. The PDP-9 was also one of the first small or medium scale computers to have a keyboard monitor system based on DIGITAL's own small magnetic tape units (DECtape).

A compact version of the PDP-9, called the PDP-9/L, was released later, selling an additional 40 units.

LINC-8

Finally that year, the LINC-8 was built, based on a previous design from the Lincoln Labs to penetrate the emerging biomedical computer market. This computer incorporated both the LINC (Laboratory Instrument Computer) processor and well-established PDP-8 processor unit.

PDP-10

During this year, a successor to the PDP-6 was announced. The 36-bit PDP-10 computer was program-compatible with the PDP-6 and approximately twice as powerful. Designed to perform conversational time-sharing, batch-processing, and real-time operations equally well and simultaneously, the PDP-10 achieved great popularity with the commercial time-sharing utilities, university computer centers, and research laboratories.

FINANCIAL SUMMARY

FISCAL YEARS	1964	1965	1966	1967
Total Operating Revenues	$10,909,565	$14,982,920	$22,776,434	$38,895,782
Income Before Income Taxes	1,780,629	1,387,025	3,500,662	8,319,760
U.S. & Foreign Income Taxes	878,015	646,140	1,550,122	3,778,555
Net Income	902,614	740,885	1,950,540	4,541,205
Total Assets	5,708,173	10,775,990	15,111,228	21,733,105
Current Assets	4,999,711	9,660,318	13,391,341	19,970,723
Current Liabilities	1,796,346	6,371,978	8,725,926	6,016,348
Stockholders Equity	3,557,452	4,365,887	6,363,427	15,707,382
No. of Shares Outstanding at Year End	22,995,000	23,220,000	24,075,000	26,190,000
Net Income Per Share	$.04	$.03	$.08	$.18

HARDWARE
- K SERIES MODULES
- PDP-8/I, PDP-8/L
- PDP-12
- PDP-14
- PDP-15

SYSTEMS
- EDUSYSTEMS
- TSS-8
- QUICKPOINT-8
- TYPESET-8
- LAB-8
- PHA-8
- COMPUTERPAKS
- IDACS-8
- RAD-8
- CLINICAL LAB-12

FINANCIAL SUMMARY

1968-1969

K SERIES MODULES

A new line of highly noise-immune K Series modules had been introduced in mid-1967. By early 1968 the success of the K Series modules was well established. Today there are approximately 200 different K Series modules, which are used for control applications in industrial computers.

PDP-8/I, PDP-8/L

In another burst of product development, two best-selling successors to the PDP-8, the PDP-8/I and PDP-8/L, were released.

The 8/I was more expandable (and expensive) than the PDP-8/S. The 8/L was a smaller OEM version of the 8/I. Both machines operated at the same speed as their predecessor.

1969

PDP-12

The PDP-12, successor to the LINC-8, was released for use in applications such as chemistry, applied psychology, patient monitoring, and industrial testing. In less than a year, four hundred orders had been placed for the PDP-12, which incorporated the PDP-8/I and LINC-8 instruction sets, making it compatible with LINC-8 software. In addition to a display-based operating system, software packages were included for data acquisition and display, Fourier analysis, and mass spectrometry.

PDP-15

The next announcement this year was the long-awaited successor to the PDP-9 and 9/L. The PDP-15, faster and less expensive than its predecessors, had the added sophistication of separate I/O processor to the CPU. Over 400 of these new 18-bit machines were ordered in the first eight months. The PDP-15 found great acceptance in both the established physics and communications markets as it added new markets such as computer-aided graphics with the GRAPHICS-15, and large real-time operations with RSX-15, a sophisticated monitor system. An average PDP-15 configuration cost $90-120,000, compared to $50,000 for the PDP-9.

PDP-14

The PDP-14 was delivered in March. K Series modules were used to develop noise-immune I/O units for this completely new, solid state controller that controlled operations by solving Boolean equations. Applications in the relay-logic marketplace included an automatic racking and stacking system, control of machine tools, and sequencing. The PDP-14/L, with reduced I/O capabilities and a lower cost, was added to the product line during the following year.

EDUSYSTEMS

Computers began coming into wide use in colleges around this time. PDP-8-based EDUsystems using the BASIC® language (developed by Dartmouth College) went a step further by bringing computers into secondary and elementary schools. Because EDUsystems start small and expand, a school could start with EDUsystem-05 and work up to EDUsystem-50 as its computing requirements increase.

TSS-8

The TSS-8 timesharing system was also developed on the PDP-8, although most systems were shipped with the newer PDP-8/I processor. This system, a multilingual, local timesharing system offering simultaneous use to as many as 32 users, supported both high-level and machine languages.

QUICKPOINT-8

QUICKPOINT-8 prepares tapes for numerically-controlled, point-to-point tools.

TYPESET-8

The pioneer of the "turn key" computer system was the TYPESET-8. This hardware and software package, originally sold with the classic PDP-8 as its CPU, later used the 8/I, 8/L and 8/E. The computerized typesetting system takes unjustified and unhyphenated type for use with hot metal and photo composition machines.

Two system packs were developed for laboratory applications—the LAB-8 and PHA-8.

LAB-8

The LAB-8 is a small, general purpose lab package that enables any PDP-8 to signal, calculate, and display the trend and variance of data, display blow-ups of areas of interest, and control the experiment.

PHA-8

PHA-8, the first in a series of complete computer systems developed for pulse height analysis, gathers, stores, displays, and analyzes energy of time-of-flight spectra and records the results on a variety of output devices. The PDP-8 family have proven to be excellent tools for the industrial lab, manufacturing plant, or physics class.

COMPUTERPAKS

During 1968-1969, a number of computer system packages, called COMPUTERPAKS, were developed based upon DIGITAL's highly successful PDP-8 computers. Special software was designed to handle a variety of applications.

IDACS-8

IDACS-8, a computerized, real-time industrial applications package, incorporated a special task-oriented language, INDAC, with data acquisition and control hardware. The SNAP feature allows the user to get a "snapshot" of the entire system, or any part of it, at any time. IDACS-8 is presently in use in hundreds of industrial control and data acquisition applications.

RAD-8

RAD-8, another PDP-8 based system, was developed by the Medical Systems Group for radiation treatment planning. In addition to calculating radiation doses, RAD-8 can be used for other therapy functions, patient record keeping, and accounting.

CLINICAL LAB-12

A PDP-12 COMPUTERPACK provided the basis for a laboratory information system, the CLINICAL LAB-12. This system was used to automate the clinical laboratory to analyze data from instruments and incorporate the results into various reports for the patient's physician.

FINANCIAL SUMMARY

FISCAL YEARS	1968	1969
Total Operating Revenues	$57,339,400	$91,244,000
Income Before Income Taxes	12,934,690	17,300,000
U.S. & Foreign Income Taxes	6,078,000	7,900,000
Net Income	6,856,690	9,400,000
Total Assets	36,496,876	62,304,000
Current Assets	33,562,457	55,081,000
Current Liabilities	13,806,354	16,915,000
Stockholders Equity	22,690,522	45,389,000
No. of Shares Outstanding at Year End	26,339,400	27,647,913
Net Income Per Share	$.26	$.35
EMPLOYEES AT YEAR END	2,600	4,360
SHAREHOLDERS AT YEAR END	595	3,586

GENERAL

TWO NEW MANUFACTURING FACILITIES

WESTFIELD

WESTMINSTER

HARDWARE

PDP-8/E

PDP-11/20

SOFTWARE

MUMPS

SYSTEMS

TABS-8

FINANCIAL SUMMARY

1970
7/69—6/70

GENERAL 1970

WESTFIELD

WESTMINSTER

TWO NEW MANUFACTURING FACILITIES

In late 1969 and early 1970, DIGITAL built two new plants in Massachusetts—one in Westfield and another in Westminster. Each plant gave the company an additional 250,000 square feet of manufacturing space.

HARDWARE 1970

PDP-8/E

Two important product announcements were made this year. The first was the introduction of the successor to the PDP-8/I. Less expensive than its predecessor, the PDP-8/E featured an OMNIBUS—a patented synchronous bus that handles bidirectional communication between system elements. By eliminating backplane wiring, and hence the need to rewire, the OMNIBUS greatly improved system reliability, simplified system configuration, and essentially eliminated system obsolescence. A single OMNIBUS contained enough slots to handle up to 32K words of core memory, or up to 10 peripheral controllers.

PDP-11/20

The announcement of the PDP-11/20, the first of the PDP-11 family of machines, caused considerable stir in the minicomputer marketplace. The 16-bit machine was the first minicomputer to interface all system elements—processor, memory, and peripherals—to a single, bidirectional, asynchronous bus. The UNIBUS enabled fast devices to send, receive, or exchange data without intermediate buffering in memory.

Both the PDP-11 and the PDP-8/E used larger circuits boards than the earlier integrated circuit machines and were built on highly automated production lines using quality control, heat and stress testing procedures never before implemented.

MUMPS

With total systems packages playing an increasing role in the computer market, the introduction of MUMPS further enhanced the PDP-15 software. MUMPS, a general purpose data management language developed at Massachusetts General Hospital, allows up to twenty-two users to simultaneously access a data base held on disk. MUMPS-15 systems have applications in such areas as hospital information, stock and warehouse control. The success of many large PDP-15 configurations that were sold with the MUMPS software led to later development of a PDP-11-based MUMPS system.

TABS-8

The first business system designed specifically for newspaper applications was installed by the Graphics Art Group in June. TABS-8 (Typesetting Applications Business System), a collection of business data processing programs that runs on the PDP-8/E, consists of six packages: Circulation, Advertising, PAI/MAIL, Payroll, Accounts Payable and General Ledger. The system was designed to handle the day-to-day detail work of the newspaper business by providing the information and reports needed to effectively manage overall operations. TABS-8 represented DIGITAL's first step in business data processing for the non-sophisticated end-user.

FINANCIAL SUMMARY

FISCAL YEAR	1970
Total Operating Revenues	$135,408,000
Income Before Income Taxes	25,500,000
U.S. & Foreign Income Taxes	11,100,000
Net Income	14,400,000
Total Assets	114,821,000
Current Assets	94,535,000
Current Liabilities	38,477,000
Stockholders Equity	76,344,000
No. of Shares Outstanding at Year End	29,019,000
Net Income Per Share	$.50
EMPLOYEES AT YEAR END	5,800
SHAREHOLDERS AT YEAR END	6,460

1971
7/70–6/71

GENERAL 1971

MILESTONES

Two milestones were reached this year. The 15,000th installation was made, and DIGITAL became the second largest computer manufacturer in the U.S. in number of installations and the eighth largest in the world in dollar sales.

GALWAY

Additional Plant facilities were added in Galway, Ireland, and expansion of the Westminster plant to 520,000 square feet was begun.

DIGITAL PARK

In Maynard, plans were underway for an industrial park.

HARDWARE 1971

PDP-11/15

A smaller version of the PDP-11/15, was released in Q2 for the expanding OEM market.

PDP-8/M

The PDP-8/M, an OEM version of the 8/E, had only one OMNIBUS mounting block, so it could be packaged in half the space of the 8/E, offering price advantages for multiple unit purchasers.

PDP-11/05

Two more products aimed at the OEM market were released during this year. The PDP-11/05 made extensive use of large board technology, giving users an improved price/performance ratio.

THREE NEW PERIPHERALS

Three new DIGITAL-manufactured devices were introduced at the 1970 Fall Joint Computer Conference: the LA30 DECwriter, a 30-character-per-second teletypewriter replacement terminal; the TU10 magnetic tape unit; and the VT05 alphanumeric keyboard terminal.

LA30

TU10

VT05

PDP-11/45

DIGITAL entered the medium-scale computer market during the year with the PDP-11/45, the most powerful member of the PDP-11 family. Starting at a cost less than $20,000, the 11/45 proved an excellent computational tool for large multi-user/multi-task installations. It combined three different types of primary memory: core, metallic-oxide semiconductor, and bipolar semiconductor and had memory management hardware to allow efficient memory utilization and expansion up to 128K. Dual-ported memories allowed overlapped computation for fast throughput. Other features included a greatly expanded floating point processor and the addition of several software systems developed specifically for the 11/45; RSTS/E, RSX-11D, and a substantially improved FORTRAN system.

RTM (PDP-16)

The PDP-16 began a new concept in small computers and digital controllers. Announced initially as the PDP-16 but subsequently renamed and now called RTMs (Register Transfer Modules), manufacture began in mid-year. This series of printed circuit modules can be tailored to any application and made to operate with or without programs. It can be used for dedicated functions in industry, research, education, and data communications where even a PDP-8/E could not be cost-justified. In terms of cost, the PDP-16 closed the gap between small logic modules and the smallest general purpose computer.

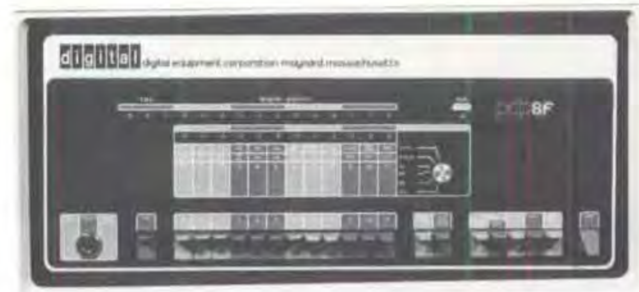
FINANCIAL SUMMARY

FISCAL YEAR	1971
Total Operating Revenues	$146,849,000
Income Before Income Taxes	18,500,000
U.S. & Foreign Income Taxes	7,900,000
Net Income	10,600,000
Total Assets	150,142,000
Current Assets	110,865,000
Current Liabilities	24,288,000
Stockholders Equity	125,854,000
No. of Shares Outstanding at Year End	30,717,000
Net Income Per Share	$.35
EMPLOYEES AT YEAR END	6,200
SHAREHOLDERS AT YEAR END	7,420

1972
7/71–6/72

GENERAL 1972

TAIWAN
After negotiations with RCA in late 1971, DIGITAL purchased their memory production division in Taiwan. This, together with advances in memory manufacture, allowed the company to decrease prices for most of its minicomputers.



PDP-8/F
The PDP-8/F, an end user version of the PDP-8/M, was introduced in March. Like the 8/M, it had one OMNIBUS but gave users the flexibility of the 8/E.

HARDWARE

PDP-16/M
The PDP-16/M, a small general purpose computer that used some of the RTM data options, was announced. Designed for customers who needed a limited machine for less than $4K, it incorporated a programmable read-only memory and a variety of options to make a highly versatile device for the OEM, educator, and systems designer.

SOFTWARE

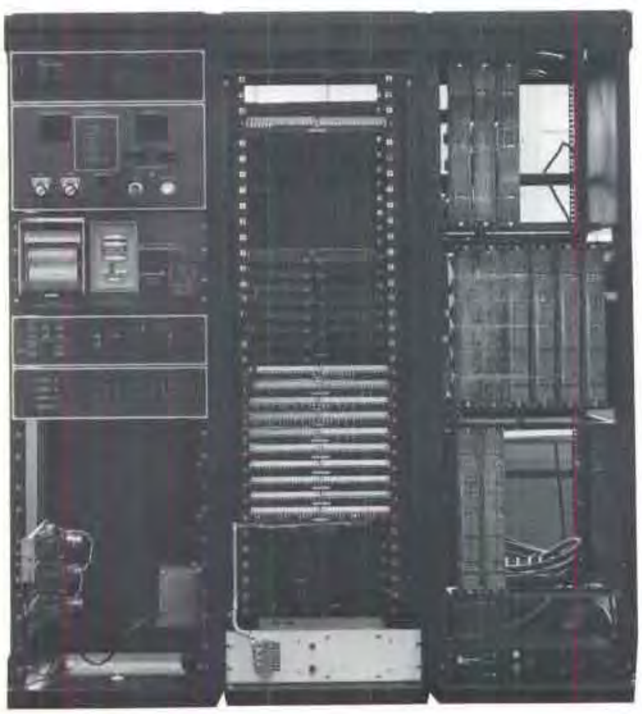
NEW PDP-11 BASED PACKAGES
Several new application packages were developed in 1971 around the PDP-11: DECcomm-11 for communications, LAB-11 for the laboratory, and IDACS-11 for industrial applications were the first.

DCM-11

LAB-11

PHA-11

Other announcements included the PHA-11 package for pulse height analysis and low-energy nuclear and electron spectroscopy applications...



IDACS-11

RSTS-11

...and RSTS-11, a resource timesharing system capable of supporting 16 simultaneous users. RSTS-11 was particularly well suited to commercial applications due to its sophisticated file handling and protection capabilities. The later addition of BASIC-PLUS, a more powerful version of the BASIC® language, greatly enhanced the RSTS systems' capabilities in the form of RSTS/E, a time-sharing system for education and computation center environments.

TYPESET-10

TYPESET-10, a "total newspaper" system designed and implemented around the powerful DECsystem-10, was announced in March. A fully redundant, high-availability computer system operating within the multi-task TOPS-10 monitor environment, TYPESET-10 offered the capability of producing high-quality typographic output concurrently with all of the other computing requirements normally encountered within a corporate structure, such as payroll, employee records, budgeting, billing, and general data processing requirements.

DECDATASYSTEMS: DDS-300, DDS-520

The formation of a Commercial Products Group led to the development of the DEC Datasystems series of business-oriented systems. These systems were aimed specifically at small commercial applications needing terminal capability not offered by small EDP computer system houses.

Software written for these systems included DIBOL and RPG (Report Program Generator). The DDS-300, the first in the series, was designed specifically for the office environment and consisted of a PDP-8/E-based system with a new Commercial Operating System, COS-300, that included DIBOL, SORT/MERGE utilities, F/B capability, and data entry package to run in the foreground.

This system was shortly followed by a PDP-11-based system. The DDS-520, based on the 11/05 processor, was a single-user batch system supporting the full line of business oriented peripherals.

TYPESET-11

Finally, the Graphics Art Group followed the successful PDP-8 based typesetting system with a new PDP-11 based system running under the multi-user DOS operating system. TYPESET-11, later released under the RSX-11D operating system, allowed copy preparation, data flow control and system management to be performed simultaneously and entire publications to be stored, proofed, edited and corrected or revised before phototypesetting the text. Copy editing and rearranging, performed off-line at DIGITAL-developed VT20 video display terminals, uses the host computer's time only for data transmission. Proof copies can be obtained from a high-speed line printer before finalized text is output to on-line photocomposition machines or paper tape punches.

NEW PDP-10 MARKETING PHILOSOPHY: DECSYSTEM-10

Late in 1971 the marketing philosophy of the PDP-10 group was changed, and the DECsystem-10 line was introduced. It was decided that the entire DECsystem-10 line would use the same basic monitor system to give users an unequalled expansion capability.

The DECsystem-10/40 and 10/50 used the established KA10 processor; a larger system, the 10/70, included the new and faster KI10 processor; and the 10/55 and 10/77 dual processor configurations that used the KA10s were added. Systems ranged in price from $400,000 to over $1.2 million.

FINANCIAL SUMMARY

FISCAL YEAR	1972
Total Operating Revenues	$187,553,000
Income Before Income Taxes	25,800,000
U.S. & Foreign Income Taxes	10,500,000
Net Income	15,300,000
Total Assets	192,416,000
Current Assets	134,765,000
Current Liabilities	47,609,000
Stockholders Equity	144,807,000
No. of Shares Outstanding at Year End	31,029,000
Net Income Per Share	$.50
EMPLOYEES AT YEAR END	7,800
SHAREHOLDERS AT YEAR END	15,430

HARDWARE
PDP-11/10
PDP-11/40
LPS-11
GT40

SOFTWARE
CAPS-8
RSX-11D
CAPS-11

SYSTEMS
UNICHANNEL-15
PDP-15/76
RK-15
GRAPHIC-76

FINANCIAL SUMMARY

1973

7/72–6/73

Two new end-user versions of the PDP-11/20 were announced.

PDP-11/10

The PDP-11/10 had additional features such as 4-level priority interrupt and multiple accumulators to allow it to run all PDP-11/20 software.

PDP-11/40

The PDP-11/40, offering approximately twice the processing power of the earlier 11/20, was also introduced. The floating point package, offered as an option, made the cost slightly lower than that of the 11/20.

LPS-11

The LPS-11, introduced in August, was designed as a low-cost, lab data acquisition system. Housed in a 5¼"-high box, the unit consisted of options designed specifically for the lab, but which could also be used in various other data acquisition markets. The various subsystems included a 12-bit A/D, D/A and scope control, a real-time clock, and a 16-bit digital I/O register. The LPS interfaced to the PDP-11 family by means of the UNIBUS.

GT40

In October, the GT40 graphic display system was introduced to fulfill the need for a fast, uncomplicated graphics system. A programmable display with standard communication interface, alphanumeric terminal and light pen, the GT40 incorporated an 11/10 minicomputer, making the system expandable with mass storage as well as with other I/O options. Used both as a smart terminal to a host computer and as a stand-alone system, it proved to be a success even before software was announced for it.

SOFTWARE 1973

CAPS-8

The convenience of tape cassette vs. papertape procedures was first demonstrated on DIGITAL machines in May of this year with the release of a cassette programming system on the PDP-8/E. CAPS-8 gave users a keyboard monitor, I/O facilities at the monitor level, and a library of system programs, with a minimum configuration of an 8K PDP-8/M, TAB DECcassette, and keyboard terminal.

RSX-11D

In May, the PDP-11/45 Product Line announced a new software system: the RSX-11D Real-Time Executive. Aimed at the sophisticated end-user, RSX11-D offered users real-time capabilities in a powerful system that included a choice of two computers, the 11/40 or 11/45, a sophisticated real-time executive, on-line program development, complete device handling capabilities, and total system protection. Typical applications were in the lab, industrial, computation, and OEM markets.

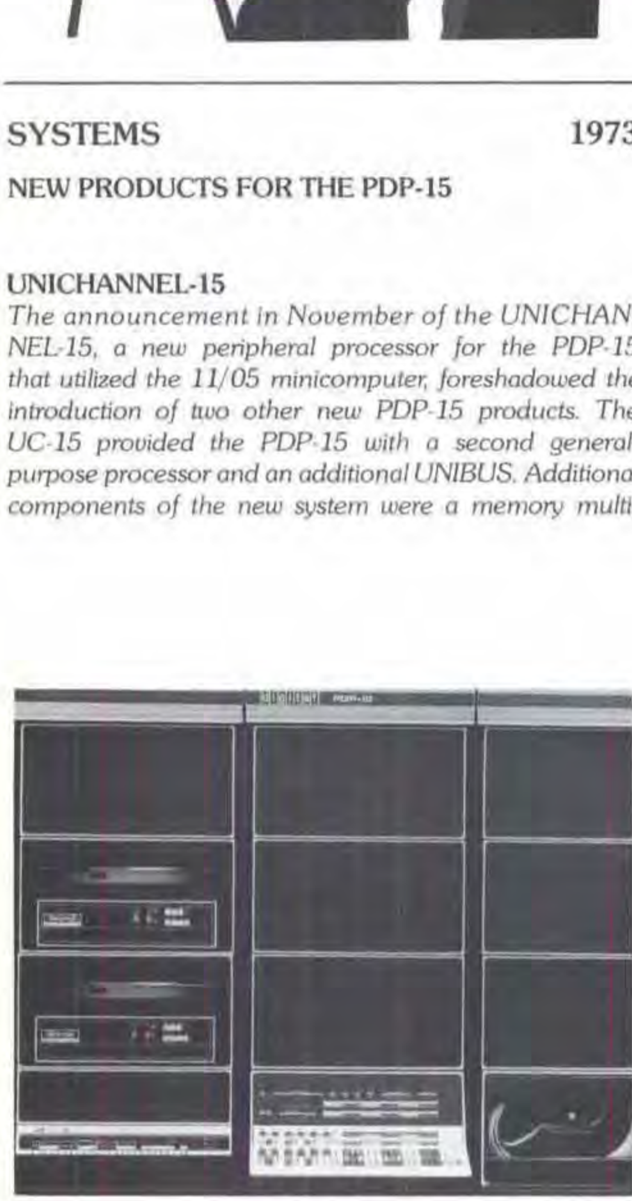
CAPS-11
CAPS-8 was followed in late June with the release of the CAPS-11 software, greatly enhancing DIGITAL's place in the PDP-11 small systems marketplace. Using cassettes as a file-structured medium to replace papertape as a development and distribution medium, CAPS-11 supports a dual cassette drive, a DECwriter, a teletype or VT05, and a line printer on a minimum 8K memory configuration with possible expansion up to 28K.

SYSTEMS 1973

NEW PRODUCTS FOR THE PDP-15

UNICHANNEL-15
The announcement in November of the UNICHANNEL-15, a new peripheral processor for the PDP-15 that utilized the 11/05 minicomputer, foreshadowed the introduction of two other new PDP-15 products. The UC-15 provided the PDP-15 with a second general-purpose processor and an additional UNIBUS. Additional components of the new system were a memory multiplexer that allowed the PDP-15 and 11/05 processors to share common memory and an "interrupt link" that provided a second means of interprocessor communications.

This announcement was followed in December by the introduction of the dual-processor PDP-15/76 and the RK15 cartridge disk system, both utilizing UC-15.



PDP-15/76
The PDP-15/76, a multi-processor, fully-integrated, hardware/software system, was designed to handle simultaneous applications such as data acquisition and data analysis, batch computation and I/O spooling to printers or plotters, graphics and plotting, and graphics and data acquisition. The system's central processor performs computation, monitoring, and file management; an integrated floating point processor performs high speed computations with up to 54-bit accuracy; a high-speed I/O processor channel drives graphics processors, A/D converters, industrial controllers, and mass storage devices; and the 11/05 peripheral processor provides automatic spooling. The system runs under DOS/BOS-15, MUMPS-15, and RSX-PLUS III, has eight applications packages, a number of utility packages, FORTRAN, and starts for under $50K.

RK-15

The RK15 Cartridge Disk System, a complete sub-system consisting of the UC-15 peripheral processor, an RK11E disk controller, and RK05 cartridge disk drive, was also introduced at this time. The system, which supports both DOS- and BOS-15 as either systems or data storage devices, gave PDP-15 users a convenient, low-cost cartridge disk system that allows them to convert a PDP-15 into a dual processor system.

GRAPHIC-76

Shortly after its announcement, the PDP-15/76 also entered the graphics market with the GRAPHIC-76, a PDP-15/76 with the GT15 stroke vector front-end and software capable of supporting four consoles under RSX-PLUS III.

FINANCIAL SUMMARY

FISCAL YEAR	1973
Total Operating Revenues	$265,469,000
Income Before Income Taxes	38,600,000
U.S. & Foreign Income Taxes	15,100,000
Net Income	13,500,000
Total Assets	287,397,000
Current Assets	216,575,000
Current Liabilities	63,851,000
Stockholders Equity	223,546,000
No. of Shares Outstanding at Year End	33,237,000
Net Income Per Share	$.72
EMPLOYEES AT YEAR END	13,000
SHAREHOLDERS AT YEAR END	14,226

GENERAL

MARKET GROUP REORIENTATION

SOFTWARE PRODUCT LICENSING

NATIONAL ACCOUNTS PROGRAM

RIMS

MARLBOROUGH

DIGITAL PARK

COMPONENTS GROUP

HARDWARE

14 CONTROLLERS: PDP-14/30, /35

PDM70

PROM-8M

MPS COMPUTER PROGRAM

RJS03/04

PDP-8A MINIPROCESSOR

8/A MODULE KIT

8/A OEM PACKAGE

TU16

SOFTWARE

RT11

RSX-11M

RSX PLUS III

SYSTEMS

STANDARD SYSTEMS

LAB-11E10

IND-1150

IND8/C

DDS-500

GT44

DECSET-8000

GT42

DATA COMMUNICATIONS PACKAGES

DDS-340

EDUSYSTEMS-100, 200, 250

DECLAB

FINANCIAL SUMMARY

1974

7/73—6/74

MARKET GROUP REORIENTATION

The start of FY'74 witnessed a significant restructuring of corporate marketing policy. The identification of many distinct customer markets resulted in a shift away from strictly product-oriented groups to discrete market groups, each serving distinct customer markets. Concurrent with this change in marketing strategy, the field sales force was realigned to reflect a market orientation.

SOFTWARE PRODUCT LICENSING

Another important change occurred in the area of marketing software products. The recent trend in the industry had been heading toward licensing of software products, both because it was no longer feasible for a company to bundle the price of software in with hardware prices, due to the increasing costs of software development, and because of the need for companies to protect their manufacturing rights to their software. So by early FY'74, corporate policy had evolved to the point that many software products were not actually sold outright to customers; rather, customers paid a license fee that entitled them to use a particular software system on a single specified Digital CPU.

NATIONAL ACCOUNTS PROGRAM

Also in July, a National Accounts Program was established to provide better servicing of large, multi-divisional, geographically dispersed customers such as General Electric, Bell Telephone, the U.S. Government, Kodak, Schlumberger, and Dupont. A similar type of program was planned for implementation in the U.K. and Europe in the future.

RIMS

In November, the Field Service Regional Computer Project became a reality with the installation, on a turnkey basis, of an 11/40 computer and Regional Inventory Management System (RIMS) at the Mid-Atlantic Field Service Regional Office in Princeton, N.J. With planned installations in Q3 and Q4 for other Regional Field Service Headquarters throughout the world, the RIMS system was designed to provide timely and accurate information to field management on the status and activity of spare parts in the Regional Stockrooms. System features included forecasting, stock record keeping, accounting information, and back order/open order inventory.

MARLBOROUGH

In January, the corporation purchased RCA's Marlborough facility, adding another 700,000 sq. ft. of administrative and manufacturing space. Its first occupants were the DECsystem-10 group.

DIGITAL PARK

Meanwhile, in Maynard, the new general purpose administration building was occupied, completing the DIGITAL PARK.

COMPONENTS GROUP

The formation of a new Components Group was announced in June. Located in the Tower at the new Marlborough facility, the group was created to sell independent peripherals totally unbundled to large-volume customers, with the intention of reducing prices and increasing volume availability of products through economies of scale in production and merchandising. Products initially offered included existing dual-cassette tape systems, data-entry keyboard terminals, logic modules, microprocessors series modules, and the PDP-8A miniprocessor.

HARDWARE 1974

14 CONTROLLERS: PDP-14/30,/35

September ushered in the second generation of programmable controllers to the Industrial line of products.

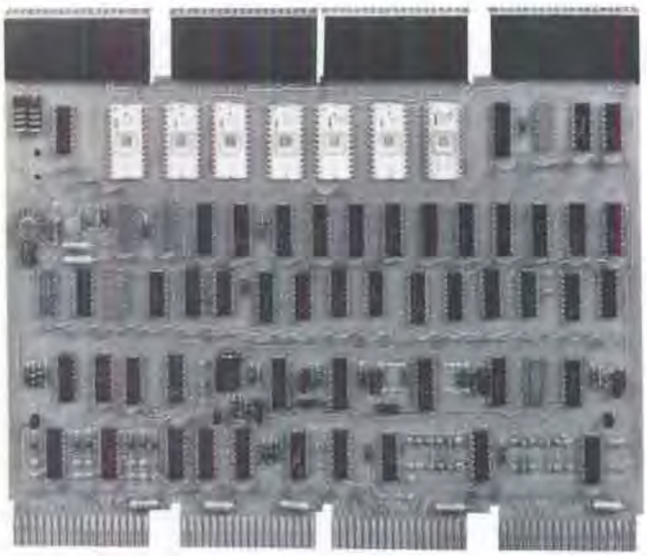
The introduction in Detroit included two new controllers, the Industrial 14/30 and the larger 14/35, and a new programming terminal, the VT14. These new products embodied significant advances in programmable controllers when compared with the original PDP-14, the world's first PC when originally introduced in 1969.

The new controllers supported approximately twice as many digital inputs and outputs using unique single point plug-in signal converters. A significant advantage is the large number of internal logic functions available to the user at no additional cost for timing, counting and shift registers.

These added capabilities are used by control engineers to effect better control methods in a wide variety of applications in all major industries. Initial shipments of the second generation of 14 Controllers were applied in automotive, chemical processing and warehousing control applications.

PDM70

A remote data acquisition system that provides an economical means of collecting and moving data from instruments and sensors to remote processors, the PDM70 is capable of standalone operation using its own memory and control or operation in a slave mode from a processor. The system is totally ASCII-oriented and is easily interfaced to computers via 20-mA current or EIA levels. The variety of option cards includes A/D, D/A, bit-parallel in/out, character-parallel in/out, and bit-serial in/out.



PROM-8M

The OEM group's announcement in November of a 1K programmable Read-Only memory, which had 256 read/write locations out of a total of 1K memory locations, opened up new application areas for the use of minicomputers. By combining the PROM and a PDP-8 CPU, the OEM group was able to offer the lowest-priced PDP-8 ever (the PROM-8M) at $2750 for the 1K PROM and $3500 for the 2K PROM. Typical applications for the PROM-8M included repetitive manufacturing operations, control applications, data collection, and instrument monitoring and measurement.

MPS COMPUTER PROGRAM

The MPS (MicroProcessor Series) product family represents DIGITAL's first entry into the world of LSI (Large Scale Integration) technology computer products. The MPS modules have been designed to supply users with reliable, low-cost microprocessor systems that can be used in process/control and data formatting or preprocessing applications. For ease of application, the MPS user can choose between an MPS self-assembler software package or elect to utilize an assembler package designed for operation on a PDP-8. An MPS based version of the high level language, FOCAL (FOrmula CALculator), is also offered through the Software Distribution Center, giving MPS compatibility with other FOCAL computer systems. To facilitate hardware interfacing, MPS is designed to be complemented by a wide variety of interfacing products offered through DIGITAL's Logic Products Group. Thus, the MPS has been designed to be an extremely flexible, inexpensive, hardware/software microprocessor system.

RJS03/04

In February, the latest in fixed head disk systems was announced for the PDP-11 family. The first in the line of high-performance peripherals designed for applications requiring high speed and reliable on-line storage, the RJS03 and RJS04 feature: fast access—8.5 milliseconds at 60 Hz, 10.2 milliseconds at 50 Hz; high speed transfer rates of 4 μs per 16 bit word for the RJS04, 4 or 8 μs for the RJS03; real-time lookahead on multidrive systems; high data reliability; and U.L. approval.

The RJS03 includes a controller and rackmounted RS03 fixed head disk drive with a 256K 16-bit word storage capacity.

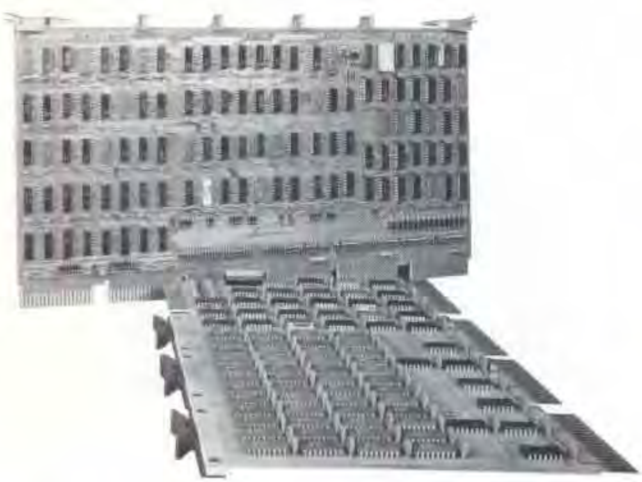
The RJS04 includes a controller and RS04 disk drive with 512K 16-bit word storage capacity. Both can be expanded with up to 8 drives per controller.

PDP-8/A MINIPROCESSOR

At the National Computer Conference in May, the OEM group introduced the PDP-8A minicomputer.

Designed with currently available semiconductor components, the PDP-8A is not dependent on custom LSI chips. Based on the OMNIBUS concept, the PDP-8A provides the traditional PDP-8 values of reliability, compatibility, and performance, offering a complete range of available peripherals, proven software, field support organization and manufacturing capabilities.

Two versions were displayed, a module kit version and a packaged configuration.



8/A MODULE KIT

The Module Kit consists of a miniprocessor on hex size board and a quad size memory board. Several memory types are offered, including Read/Write RAM, ROM and PROM in 1K, 2K and 4K increments, up to 32K.

8/A OEM PACKAGE

In the packaged version OEM's can choose the type and quantity of memory they need plus a 19-inch wide chassis, a power supply, cooling fans, an eight slot OMNIBUS, and an operator's function panel. The PDP-8A package prices began at $1745 for the 1K RAM model.

TU16
In June, the second in the line of high-performance peripherals was announced.

The TU16 expanded DIGITAL's magnetic tape product line. Offered in both 800 and 1600 bpi or 800 bpi only, the TU16 provides considerable second generation improvement over its still viable predecessor, the TU10.

RSX-11M
A real-time, multi-programming, program-development system with a disk-based operating system, RSX-11M offered the user the following features: it can operate on all PDP-11 processors and is a fully compatible subset of RSX-11D; it can operate with or without memory management (memory management support is a system generation option) in a 16K memory PDP-11 with 8K available for either foreground or background operation and provide simultaneous background and foreground operation in systems with 24K or more memory; and can support both synchronous and asynchronous communications hardware.

SOFTWARE 1974

RT-11
DIGITAL's entrance into the low end of the real-time market came in July with the announcement of RT-11. With its single-job monitor and F/B monitor, RT-11 was designed for the single user involved in program development and/or real-time applications, providing fast, simple, on-line access to any PDP-11 processor with at least 8K of memory and mass storage (16K words for F/B). The system offers the user two high-level languages, BASIC/RT-11 and FORTRAN IV-RT-11 and is upwards compatible for users who need to grow from CAPS-11. Basic system components consist of an 8K PDP-11/10 CPU, LA36, cabinet, Cassette, Bootstrap, and RK-11 disk cartridge system.

RSX PLUS III

In late Q4, the PDP-15 Group announced the latest monitor for the PDP-15, RSX PLUS III, a real-time/batch, multiprogramming system. Highlights of the new system, which had built in many features and improvements to its predecessor, RSX PLUS, included: upwards compatibility with RSX PLUS; UNICHANNEL support for spooling and multiprocessing; time slicing over a task priority range, on-line repartitioning, on-line addition of new devices, RSX and DOS co-resident on disk; improved RSX BATCH and Task Development.

IND-1150

SYSTEMS 1974

STANDARD SYSTEMS

Along with the change in market orientation occurred an increasing emphasis on selling total systems. In keeping with the industry-wide trend, DIGITAL adopted the Standard Systems concept, which specifies a complete, ready-to-run system, provides an optimum system configuration, allows faster deliveries, and gives customers the best value for their money. Standard Systems are presently offered by the LDP and Industrial Products Groups.

LAB-11 E10

IND8/C

DDS-500

In July, the Business Products Group (formerly the Commercial Group) introduced their new DEC Data System 500 series. This series, which replaced the earlier 11/05-based series, utilized the PDP-11/40, 11/45 and 11/50 computers, together with several comprehensive operating systems—Commercial Operating System, Commercial Time Sharing System, and Commercial Data Management System (MUMPS)—to provide considerable flexibility to meet the needs of the commercial user.

DECSET-8000

In October, the first installation was made of the DECSET-8000, a multi-task, computerized typesetting system that provides the combined capabilities of four systems. A production and editing system permits both on-line and off-line editing. A complete classified ad system also produces transient billing data for the TABS-8 advertising business system. A complete wire service system includes stripping, storage, and editing, and a production management system facilitates continuous copy flow through each stage of production, continuously updated file information and production statistics, and classified billing information.

GT44

The GT44 was added to the line of graphics products in September. Designed for the user who needed an operating system with graphics capability yet did not need the power and sophistication of the PDP-15, the GT44 represented a price/performance breakthrough due to its "mini-system" concept. This concept simply means manufacturing the minimum "system" rather than the sum of its parts, hence passing considerable savings on to the user. The GT44 offers a complete system—both hardware and software—with a sophisticated operating system (RT-11) and a high-level language, BASIC-GT, for program development.

GT42

The Graphic Display Systems Group also announced at this time its latest product, the GT42. An expandable, intelligent graphics terminal that performs the same functions as the GT40 but features a "big box" 11/10, the GT42 is mounted in a short cabinet that will accommodate up to 16K of core plus a 17" CRT that gives a 50% increase in viewing area over the GT40. FOCAL-GT software on paper tape accompanies the system, giving it the capability to communicate with a host computer, but with the 11/10 performing computation and program execution so that it can function as a standalone system.

DATA COMMUNICATIONS PACKAGES

During the fall, the DECcomm Product Line introduced several new software products. DOS-COMTEX was announced in November, followed in December by two new remote computer systems, DOS-2780 and CORE-HASP.

DOS/COMTEX, a disk Communications Systems Base added device support and file-handling capability for COMTEX users.

The DOS-2780 Remote Computer System allowed data transmission between a PDP-11 and a central IBM 360/370, as well as transmission between two PDP-11's emulating IBM-2780 remote batch operation.

The new CORE-HASP Remote Computer System permitted transmission of jobs prepared on punched cards over leased or switched lines to an IBM-360 OS/HASP or OS/HASP System for processing and simultaneous reception of output from an IBM HASP station on a line printer.

EDUSYSTEMS-100, 200, 250

In March, the Educational Products Group extended its product line offering with EDUsystems-100, 200, and 250.

EDUsystem-100 is a one-to-eight-user, core-only system that uses a very powerful BASIC language processor. EDUsystem-200 is a 100 with the added capability of employing files as a main storage device. EDUsystem-250 adds the foreground/background feature of RT11 to EDUsystem-200, allowing the user to run from one-to-eight tasks under multi-user BASIC simultaneously with one FORTRAN IV or assembly language task.

DDS-340

Concurrent with the Education Products and Display Systems announcements, the Business Products Group announced the expansion of their 300-series with the DDS-340, an inexpensive, general purpose, multi-terminal system featuring foreground/background and multi-terminal DIBOL (MTD). The minimum hardware configuration requires a DDS-340, 4K of memory, and a VT05 for F/B; 8K of memory and an additional VT05 for MTD. The system supports up to seven terminals, 4 RK05 disks, and a papertape reader/punch.

DECLAB

The first DECLAB shipment was also made in March. DECLAB was the second of the new line of "mini systems" that enable customers to realize substantial savings when ordering specific configurations for their facilities. The new system price of $37,500 was 20% below the Company's previous equivalent systems.

System components are a PDP-11/40 minicomputer with 16K of memory, independent graphics processor, 12-inch CRT display, two disk packs, LPS-11, and DECwriter. Software consists of RT-11 and SPARTA, a new, modular signal processing software package.

FINANCIAL SUMMARY

FISCAL YEAR	1974
Total Operating Revenues	$421,884,000
Income Before Income Taxes	68,900,000
U.S. & Foreign Income Taxes	24,500,000
Net Income	44,400,000
Total Assets	440,270,000
Current Assets	324,156,000
Current Liabilities	85,536,000
Stockholders Equity	339,645,000
No. of Shares Outstanding at Year End	35,796,000
Net Income Per Share	$1.27
EMPLOYEES AT YEAR END	17,600
SHAREHOLDERS AT YEAR END	14,393

GENERAL
- TELCO
- MILESTONE

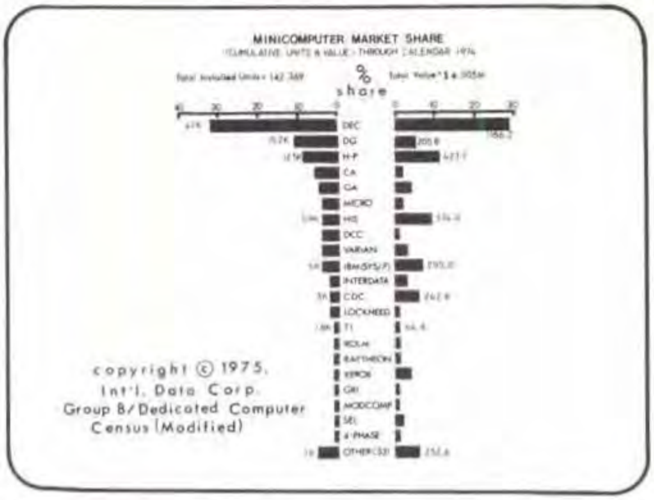
HARDWARE
- RP04
- LA36
- AR11
- VT-11
- VT50 DECSCOPE
- KL-10
- TU70
- 8/A-200, 400
- TU45
- PDP-11/04
- LSI-11
- PDP-11/70
- ICS, ICR
- NEW SYNCHRONOUS MULTIPLEXER: DV11
- TS03
- RX01
- PDP-11/03
- VT55

SOFTWARE
- RTS-8
- IAS
- FORTRAN IV-PLUS
- PDP-11 COBOL
- DECNET

SYSTEMS
- DATASYSTEM 535
- DECCOMM 600
- PDP-8/A BASED SYSTEMS
- CMS/1
- DEC DATASYSTEM 310
- CLASSIC
- PDL
- XVM SYSTEMS
- INDUSTRIAL 850 AND 840 SERIES

FINANCIAL SUMMARY

1975
7/74–6/75



TELCO

On July 1st, the Telephone Industry Products Group, which had operated under the DECcomm umbrella since 1972, was officially announced as a separate product line. By thus dividing the Communications Group, in recognition of the great business potential of the telephone industry, DIGITAL increased its ability to concentrate on developing all aspects of the telephone business, through both Bell Labs/Western Electric and directly to Bell and independent operating companies.

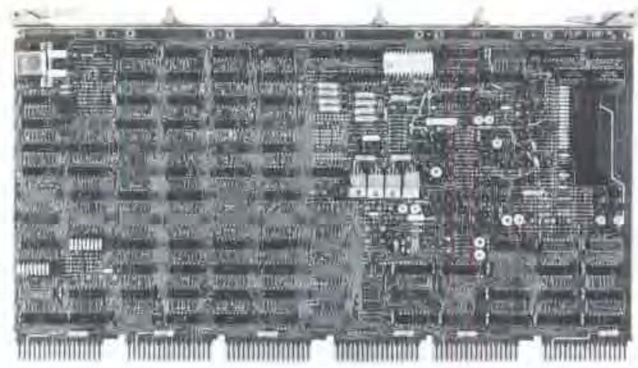
MILESTONE

During the year, the company installed its 50,000th computer system and maintained its standing as the leading mini-computer manufacturer, both in terms of market share and dollar value.

RP04

In July, a new high-performance mass storage device was introduced. The RP04 disc-pack drive, a low-cost-per-bit, direct access device for use on PDP-11/35, 11/40, 11/45, 11/50 and DECsystem-10 computers, represents a new generation of DIGITAL's mass storage disc devices. Features include 88 million bytes of formatted capacity, a transfer rate of 1.25 microseconds per byte, 36 millisecond average access time, error detection/correction, overlapped positioning with multiple drives, and the latest in reliable reading and recording techniques.

Also available is a programmable option, designated Dual Access, which allows two computers to share up to 8 RP04's.



AR11

The LDP Group added in August a new, cross-product line analog subsystem to its line of data acquisition subsystems for the PDP-11. At one-half the price of competitive systems, the AR11 combines a 16-channel A/D, scope control, and real-time clock on one board, in addition to providing its own power supply, derived from the +5 V logic power used by the CPU. Subset compatible with the LPS11, the AR11 is supported under BASIC®, FORTRAN, and Lab Applications with only slightly modified LPS software.

LA36

In August, a month that put many new products into the marketplace, a new generation of keyboard terminals was heralded by the announcement of the LA36 DECwriter II. The DECwriter II uses the latest technology to provide greater functionality at substantially lower prices than the LA30 DECwriter, which it replaces. Compatible with existing LA30 software and verified on all the major operating systems, the LA36 provides up to 132 column print capability, adjustable-width tractor paper feed system, upper and lower case character printing, up to six part paper handling, quiet operation, 7 x 7 dot matrix print head, and a multi-key rollover keyboard, which uses calculator type technology. True 30 cps operation, whereby no fill characters are needed for carriage return/line feed, is accomplised by buffering the characters received during a carriage return and line feed and activating 60 cps print mode to catch back up to the communications line.

VT-11

A new UNIBUS option, the VT-11 Display Subsystem used in GT42 and GT44 systems, was announced by the Graphic Display Systems product line in August, making graphics capability available to a wider range of PDP-11 users.

VT50 DECSCOPE

Following the successful entrance of the LA36 DECwriter II into the highly competitive terminals market, DIGITAL introduced in September a new video display terminal—the VT50 DECscope. A microprocessor-driven, alpha-numeric display terminal competitively priced with standard 10-character-per-second mechanical teletypewriter devices, the VT50, a soft-copy device, includes such features as three-key rollover, audible/tactile feedback, typewriter-like keyboard layout, up to 9600 baud transmission/reception rates, controllable display rates, and few mechanical parts. These features make it markedly faster, quieter, easier to use and maintain, and considerably more reliable than an electro-mechanical device, all for a price that puts it within the range of customers who presently can only use 30 char/sec. hard-copy devices.

KL-10

The DECsystem-10 group announced in October two new systems, the 1080 and 1090, built around the new KL-10 central processor. Twice as fast as its predecessor, the KI-10, and four times as fast as the earlier KA-10, the KL-10 features 386 micro-programmed instructions, emitter coupled logic (a state-of-the-art technology), and a 125 nanosecond access time cache, or buffer memory. One of the more significant features of the KL-10 is the Console Diagnostic Computer, which uses a PDP-11/40 to perform those functions.

TU70

Coupled with the announcement of the KL-10 was the release of information on the TU70 series. This series of high-speed magnetic tape drives represents the latest design in tape transport technology. The TU70 is a 200 inch/second, 9-track transport with program selectable recording density of 800 and 1600 characters/inch. The TU71 is a 200 inch/second, 7-track transport with program selectable recording densities of 200, 556 and 800 characters/inch.

8/A-200, 400

Two new members of the PDP-8/A family were added in December, extending its line to the full range of memory configurations.

Available with almost all standard PDP-8 options and peripherals, the 8/A-200 consists of the present PDP-8/A single board central processor, a new 4K semiconductor chip RAM memory, power supply, battery backup, an operator's console, chassis, and 12 slot OMNIBUS. The new semi-conductor memory utilizes a new 4K MOS (RAM) chip, mounted on a hex size board, providing a more reliable and less costly 4K memory package than either core or previous semiconductor memories. The one hour memory-refresh battery back-up is provided as a standard feature, since semiconductor memory is volatile.

The PDP-8/A-400 is the same basic configuration as the 8/A-200, using the same single-board processor, but offers two new single-board core memories. The new memories which plug into only 1 OMNIBUS slot, are available in both 8K and 16K configurations, allowing the 8/A-400 to accommodate up to 32K of main memory. With DIGITAL's high volume production and new packaging techniques, this product offering is available at the lowest price in the industry.

PDP-11/04

A new, low-cost, third-generation member of the PDP-11 family, designed specifically for OEM's, was released in December. The PDP-11/04, completely software and UNIBUS compatible with the 11 Family, unbundled some of the standard features of the PDP-11/05, enabling it to be offered as a low-end price leader. Featuring the CPU on single hex module and either a 4K or 8K MOS memory on a single hex-size module, the 11/04 is completely program compatible with the 11/05, providing all the 11/05's processing capability at significantly higher speed.

TU45

The Computer Special Systems Group expanded the Corporation's magnetic tape offerings in February with the introduction of a 75 ips tape transport, the TU45. Software compatible with the TU16, the new tape system was designed to fulfill the needs of users requiring higher tape throughput on a PDP-11-based system.

LSI-11

Large Scale Integration (LSI) technology has made possible the achievement of high performance and reliability in smaller packages and at lower costs. The LSI-11, announced in February, takes advantage of these factors by using this technology to provide true minicomputer performance in microcomputer packaging and at microcomputer pricing.

Directed towards OEM's and large volume end-users whose applications require the computer to be buried inside the final applications product, the LSI-11 is applications oriented in that it is a complete computing system (CPU, Memory and I/O) on one board. Yet, as a member of the PDP-11 family, it offers potential users the benefit of DIGITAL's years of experience with installed PDP-11's, plus libraries of software, documentation and training aids.

The LSI-11 Family of products consists of a microcomputer module, four expansion memory modules (ROM, PROM, RAM and CORE), two I/O interface modules (serial and parallel), and a back-plane/card guide assembly, giving users the flexibility to buy the absolute minimal system and expand it to meet the application's requirements.

PDP-11/70

Another major product announced in February was the PDP-11/70, "big brother" to the PDP-11/45 that pioneered the medium-scale systems marketplace and established DIGITAL as its leader. The newest price/performance leader in the medium-scale computer marketplace, the PDP-11/70, representing the high end of the PDP-11 architecture with the capacity for supporting the speed, addressing range and bandwidth required in large systems applications. In particular, the 11/70 offers performance-conscious PDP-11/45 users in a medium systems environment a growth path for long-range, higher throughput requirements.

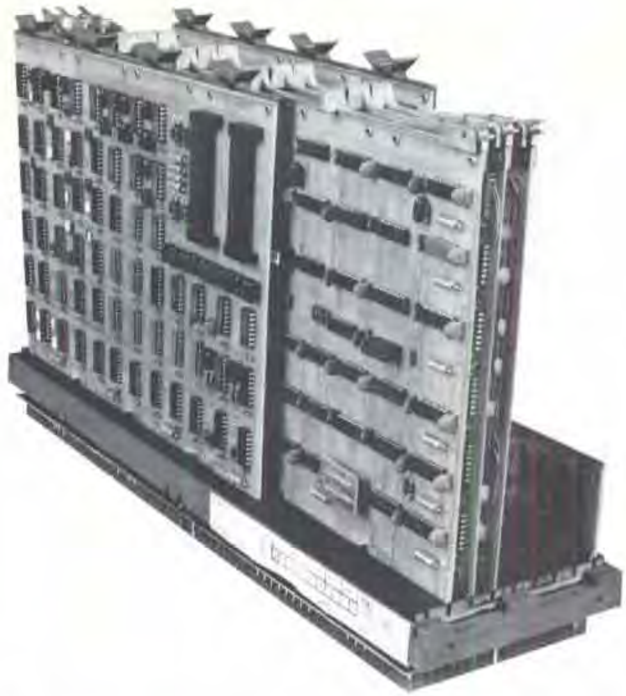
By providing extensions to RSX-11D and RSTS/E to take advantage of the power of the 11/70, software also plays a major role in the new system.

ICS, ICR

In March, the Industrial Products Group introduced new Process Control I/O interface hardware. The Industrial Control Subsystem (ICS) is available for both PDP-8's and 11's; the Industrial Control Subsystem Remote (ICR) is available for PDP-11's.

The ICS offers many significant advantages over the UDC, which it replaces: to mention a few, the functional I/O modules and signal conditioning are combined onto one hex-size module, and it contains its own power supply.

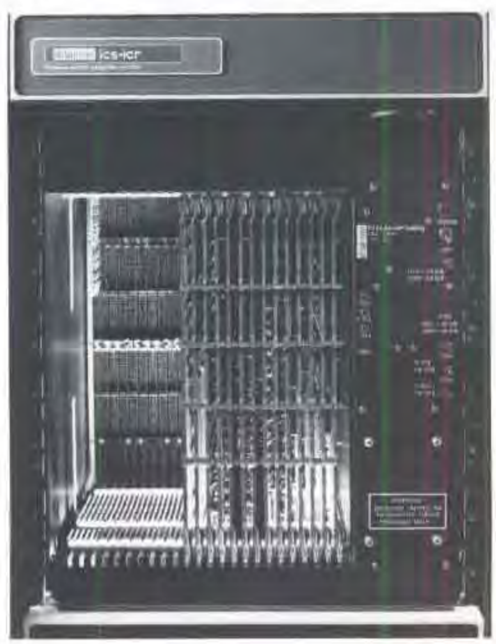
The ICR, a variation of the ICS, can be located remotely from a PDP-11 for distances up to 6000 feet. The ICR represents state-of-the-art technology for remotely locating process I/O interface hardware. A full complement of functional I/O modules is available for the ICS and ICR, including DC and AC voltage sense and interrupt, I/O counters, DC and AC outputs D/A and A/D converters.



NEW SYNCHRONOUS MULTIPLEXER: DV11

A new, competitively-priced, high-performance synchronous multiplexer that connects the PDP-11 to up to 16 lines was announced in March. Designed to relieve the PDP-11 system of much of the load involved in interrupt handling, special character processing and CRC/LRC calculations, and because it performs most of the protocol processing needed to support multiple synchronous lines, and is therefore more than simply an "interface", the DV11 is a true communications preprocessor.

Major applications are in the areas of a PDP-11 communicating with several other computers or a PDP-11 communicating with several buffered terminals.



TS03

A further extension to the Corporation's magtape product family was announced in April. The TS03, a 12.5 ips, 800 bpi, tension arm magnetic tape subsystem using 7" reels, offers a highly reliable magtape subsystem suited to the needs of customers requiring economy systems. Other significant features include its small physical size, low power consumption, and silent operation.

The low cost of the TS03 makes it attractive for data logging, interchange, bulk storage, and RK05 fail-safe applications in small systems. Since software is distributed on 7" tape reels, the TS03 can also be used for inputting operating system software to the system. In cases where only a small portion of a 10½" reel will be used and a high transfer rate is not needed, the TS03, priced below the TU10, provides an alternative for economy-minded users.

RX01

The RX01 Floppy Disk system, using a "diskette" or "floppy" medium, was introduced in May. A highly-reliable, random access, low-cost mass storage device for data interchange and software distribution on PDP-8 and PDP-11 systems, the RX01 is capable of storing up to 256K eight-bit bytes per drive in an IBM-compatible format. It can be used in the same applications as a TU56 DECtape or a TU60 DECcassette, but has better cost/performance and uses an industry-compatible medium.

PDP-11/03

In response to the interest generated by the introduction of the LSI-11, the Components Group announced in June a packaged version called the PDP-11/03. Positioned between the LSI-11 and the PDP-11/04, The PDP-11/03 is aimed at those users who require an entire/complete computing system (power supply, fans, enclosure, operator's panel, etc.) from which to begin their own development, providing cost-effective solutions for applications requiring a systems tool product.

VT55

The VT55, a new plotting graphic display in a terminal, introduced in June by the Lab Data Products group, represented a major design achievement. Designed for applications in which users perform data analysis and display, as well as interact with the system via a keyboard, the VT55 offers significant cost advantages over conventional approaches by combining the operation of a CRT data display with that of the system console terminal. In addition, the text and data are stored in the VT55, freeing computer memory and relieving the CPU of the workload of image display since the VT55 uses its own memory and refreshes the screen from it via hardware techniques.

RTS-8

RTS-8, a real-time, multi-programming development system for the PDP-8 family, was announced in July. Designed to control the execution of tasks previously built on the popular OS/8 operating system, RTS-8 features an executive that occupies less than 700 words of core and controls up to 63 fixed-priority tasks and runs on any PDP-8 processor (except 8/S) in any configuration. Particularly in combination with the 8/A, RTS-8 provides minicomputer performance at microprocessor prices.

IAS

A major new multi-function operating system was introduced concurrent with the PDP-11/70. The Interactive Application System (IAS) provides users multi-function (time-sharing/batch/real-time) and multi-language (FORTRAN/BASIC/COBOL/MACRO) capabilities.

The system emphasizes protection and ease of use for the non-technical user via the new Corporate standard command language. The real-time capabilities are the same as those in RSX-11D, and the system is file-and-task-compatible with it.

FORTRAN IV-PLUS

FORTRAN IV-PLUS, an optimized, in-line FORTRAN compiler, was also announced in July. Requiring a minimum task area of 16K words main memory, this compiler was designed to run under the RSX-11D operating system on a PDP-11/45 equipped with a floating point processor unit, thus making the speed and power of the PDP-11 architecture available to higher-level programmers. It was released later in the year under the newer RSX-11M operating system, lowering its entry-point into the PDP-11 Family and enhancing its competitive stance in the medium system market.

PDP-11 COBOL

Another significant software announcement was made in October with the release of PDP-11 COBOL, the first ANSI-74 COBOL compiler on the market. Run under the RSX-11D operating system, PDP-11 COBOL is designed to provide fast, direct access processing for commercial applications, leading to reduced cost, better use of computer resources, and minimized human error. The disk-resident compiler not only accepts source program input from cards, consoles and disks, but has the ability to accept source text from library files. Compilation and execution of COBOL programs by the PDP-11 systems are characterized by a high throughput rate and efficient memory utilization.

DECNET

With the announcement of DECNET in mid-April at DECUS, DIGITAL expanded its communications software offering to support most major operating systems, including RSX-11D, RSX-11M, RSX-11S, RSTS/E, RT-11, IAS, RTS-8, and TOPS-10.

DECNET, DIGITAL's name for integrated computer-to-computer communications capability, allows PDP-8's, PDP-11's and DECsystem-10's to be integrated into a network based on each system's unique capabilities.

Unlike competitors' networks offerings, DECNET is not a terminal network, but is a true computer-to-computer capability for distributed computing systems.

SYSTEMS 1975

DECCOMM 600

DIGITAL's experience with real-time operating systems, such as RSX-11D, and medium-sized time-sharing systems, such as RSTS/E, indicated the existence of a substantial need for systems that could provide optimum performance in transaction-oriented applications where data communications are a major requirement.

In response to this need, DIGITAL added TC/D to RSX-11D to create a complete transaction processing system called DECCOMM 600 for use by users with communications-intense, transaction processing applications.

DATASYSTEM 535

In September, the Business Products Group expanded the range of its product offering with the introduction of the small, low-cost, DEC DATASYSTEM 535, a small 11/40-based system that supports up to four terminals and eight RK05 cartridge disks.

PDP-8/A BASED SYSTEMS

The development of the PDP-8/A paved the way for DIGITAL's introduction to minicomputer-based systems into the highly competitive small business computer market, and programmable calculator market.

In response to the growing demand by users for small, low-cost computer systems, the Business Products, Education Products, and Engineering Computation Products announced the first in a series of a new PDP-8/A based products, the DIGITAL minisystems, for their respective marketplaces.

By integrating a set of components into a single entity, attractively packaged in an integrated desk, the DEC DATASYSTEM 310, the CLASSIC, and the CMS/1 offer easy-to-operate, highly reliable, low-cost systems capable of running high-level languages and providing on-line storage. These systems provide one hundred times the power of a programmable calculator at one-half to one-third the cost and ten times the power of an accounting machine at one-half its price.

CMS/1

The CMS/1, first in the new series of computational mini-computer systems designed for engineering firms and computational applications needing multiple, dedicated, low-cost, FORTRAN-IV-oriented systems, has the same basic configuration as CLASSIC, less the copier. CMS/1 provides both extension kits for OS/8 (FORTRAN-IV, BATCH BASIC, TECO) as standard features. Options include printers, communications interfaces, and additional diskette and memory devices.

DEC DATASYSTEM 310

The DEC DATASYSTEM 310 was designed to be sold by the dozens to large corporations and through Business Products OEM's to the small business in need of a small accounting machine.

For the small business, the DS310 becomes a low-cost solution to accounting problems by automatically performing many business functions that are performed manually.

For the large corporation, the DS310 can be used in a distributed data processing environment.

CLASSIC

The Classroom Interactive Computer provides educational institutions, particularly secondary schools, with a classroom tool they formerly could not afford. The CLASSIC package comprises a complete system (16K word PDP-8/A, dual floppy disk, VT50 DECscope and electronic copier, and standard OS/8) that includes application and curriculum packages consisting of documentation and ready-to-run programs.

PDL

Another low-cost system, based on the DECLAB 11/10B, was introduced in February by the Lab Data Products Group.

The Programmable Data Logger (PDL), developed for use in hospital and independent clinical laboratories, is designed to collect, record and calculate data from up to 15 laboratory instruments and includes specially designed interfaces that allow the computer to be directly connected to clinical lab instruments.

PDL offers lab users the benefits of computer power and efficiency, together with the simplicity and convenience of a calculator at calculator prices.

XVM SYSTEMS

XVM Systems, the newest extensions to the PDP-15 family, were announced in April. Both a stand-alone system and an option for already installed PDP-15's, XVM offers program size up to 128,000 words and, compared to former PDP-15 configurations, up to 30% faster execution speed and up to 18% reduction in prices. The two basic XVM systems available are XVM-100 (single-processor) and XVM-200 (dual processor). For both arrangements, the nucleus of improved performance is the XVM memory processor, a unit that furnishes instruction look-ahead and sophisticated memory management. New operating systems supported by XVM are XVM/RMX, XVM/RSX, XVM/DOS, and XVM/MUMPS. Intended to markedly enhance 18-bit capability in the computer-aided design field with multi-terminal graphics systems for general-purpose use, or for applications in architectural design, electronic circuit layout, factory layout, and cartography, the XVM series maintains full upward compatibility with current PDP-15 hardware and software.

INDUSTRIAL 850 AND 840 SERIES

The price/performance of the PDP-8A and its new peripherals permitted the implementation of computers for industrial applications which previously could not be justified. In response to this new opportunity, the Industrial Products Group announced its new 850 and 840 series of Standard Industrial Systems in May.

These new offerings combine the PDP-8A, 8A options, Floppy Disk, the IDC and a new release of OS8/Industrial BASIC Software to provide Industrial tools at prices previously not possible.

FINANCIAL SUMMARY

FISCAL YEAR	1975
Total Operating Revenues	$531,774,000
Income Before Income Taxes	73,600,000
U.S. & Foreign Income Taxes	27,600,000
Net Income	46,000,000
Total Assets	565,069,000
Current Assets	412,160,000
Current Liabilities	78,958,000
Stockholders Equity	394,385,000
No. of Shares Outstanding at Year End	36,066,000
Net Income Per Share	$1.28
EMPLOYEES AT YEAR END	19,000
SHAREHOLDERS AT YEAR END	15,033

1976

7/75-6/76

MILESTONES/FISCAL 1976

JULY, 1975
Customer Spares product line is formed.

SEPTEMBER, 1975
50,000th computer system, a PDP-11/50, is delivered.

DECEMBER, 1975
Plans are announced to build plants in Ayr, Scotland, and Salem, New Hampshire.

JANUARY, 1976
Introduction of the DECSYSTEM-20, lowest-priced, general-purpose timesharing system on the market.

MARCH, 1976
Space is leased in Acton, Massachusetts, and Nashua, New Hampshire.

JUNE, 1976
Colorado Springs is chosen as a plant site.

HARDWARE 1976

4K BIPOLAR PARITY MEMORY (MS11-AP) FOR THE PDP-11/45-11/50

In July, a fast (300 to 330 nsec.) solid-state parity memory up to a total of 32K per CPU was offered for the PDP-11/45 or 11/50. This memory significantly boosted the performance of the PDP-11/45 and 11/50.

11T40

In August, a new standard in disk-based systems was announced, the 11T40. The 11T40 is an extremely attractive system which can be used as a complete system by adding RT-11 or RSX-11M and is an exciting starter system for RSTS/E and RSX-11D.

The PDP-8/A-800 Series

The PDP-8/A800 is a PDP-8/A designed for customers who need fast FORTRAN IV and floating point with extended precision arithmetic at a low cost. The FPP 8/A processor itself is on two hex modules and plugs directly into the 8/A OMNIBUS. The 8/A800 brings the computational power of much larger and more expensive systems to the user with a limited budget.

The PDP-8/A-820 is a twenty slot version of the 8/A800 system consisting of the 8/A420 and the FPP-8/A floating point processor. The PDP-8/A420 twenty-slot version of the 8/A400 computer was introduced to meet customer requirements for additional slots and power.

LA180
In September, the LA180 DECprinter I was offered by the Corporation. The LA180 is a receive-only printer capable of printing at the rate of 180 characters per second. The machine is an expansion of the family of printing devices based on the LA36 mechanism. The LA180 is a parallel interfaced machine capable of driving up to one hundred feet of cable. Standard features include electronic Head of Form, paper out switch, six part forms, 132 columns, upper/lower case printing, paper out override, and self test mode.

VT55 HARD COPY UNIT
The VT55 is an on-line interactive CRT Terminal that offers waveform graphics, complete alphanumerics and hardcopy output. The user can obtain a hardcopy reproduction of the display screen for both characters and graphs.

VT52
As an addition to the VT50 family, the VT52 was designed to sell into programming, time sharing, and text editing applications. The VT52 has more performance than a VT05 and is an enhanced version of the VT50. In addition, the 19-key cluster pad on the VT52 provides numeric keys for data entry in Business, Financial, or Industrial applications.

There are four cursor control keys and three unlabeled function keys. These seven keys transmit escape sequences which can be used by the customer as special function keys. In addition, software can place the terminal in a mode in which each key on the keypad transmits a unique escape sequence. This allows the customer to define all 19 keys for a particular application.

RK05J
In September, a milestone was reached in DIGITAL's highly successful program to significantly improve the reliability of RK05 disk drives with the designation of RK05J. This dramatic improvement in reliability and read/write performance of the RK05 resulted in a decision to redesignate this new product as the RK05J. The RK05J is the result of significant changes in the engineering design, tighter incoming inspection, improved assembly techniques, rigid quality control, and exhaustive testing prior to customer shipment.

MPS PROGRAM

The MPS Microprocessor Series modules have been designed to supply users with a reliable, low-cost microprocessor which can be used in process/control systems, as well as in data formatting or preprocessing applications. The MPS modules make up a very flexible microprocessor system which is part of the Logic Products family of modules. Logic Products' interfacing modules complement the MPS system. These modules, standard products available in single or large quantities, allow low-cost interfacing of MPS to almost any electrical device.

11V03

The PDP-11V03 was the first complete system available from DIGITAL that is based on the LSI-11 processor and option series. The 11V03 is a roll-around RT-11 system.

NEW LA35 AND LA36

In November, new option-expandable models of LA35 and LA36 DECwriter II were offered for sale by the Corporation. Also offered was an extensive list of options which increased forms handling and communications capabilities. This product has since become DIGITAL's most successful product.

DMC11 NETWORK LINK

In November, the DMC11 Network Link was announced. The DMC11 Network Link is designed for high performance inter-connection of PDP-11 computers in network applications. The DMC11 substantially enhances the performance of DECNET and is supported in all PDP-11 DECNET systems. It also is to be supported in the RSX-11M system, independent of DECNET.

The DMC11 offers a number of advantages over conventional interfaces which require a combination of hardware and software to implement a protocol. Programming is greatly simplified. Programming the DMC11 does not require extensive communications expertise. PDP-11 memory and processor time are not wasted with instructions implementing the protocol. Throughput is enhanced, because the DMC11 microprocessor operates at high speed and is not delayed when the processor has to perform high priority tasks.

FPP-11C FLOATING POINT UNIT FOR THE 11/70

In November, a new performance option for the PDP-11/70 was announced. The FP11-C is a high performance floating point option that is twice as fast as the Floating Point Unit that was currently available, FP11-B. The FP11-C represented the latest step toward total system performance.

DUP11

In November, the DUP11 single-line, synchronous interface was announced. The DUP11 is similar to the DU11 but with several new capabilities. The most important of these is the ability to operate with the new IBM SDLC protocol and other similar new bit-oriented protocols such as HDLC, ADCCP and X.25. The DUP11 also offers enhanced operation with our DDCMP protocol. The DUP11 is our first product with the SDLC capability and shows our commitment to continued communications with IBM. The DUP11 can also be used for DECNET communications using the DDCMP protocol.

PDP-11F10

In November, a newly configured standard system was made available—the PDP-11F10. It offers the advantage of a single order number for all hardware comprising the system, assuring a complete and functioning configuration.

TU45 TAPE SYSTEM

The TU45 enabled DIGITAL because of its speed and reliability to sell large systems which could not be satisfied with lower speed units. Typical applications include disk back-up, tape interchange and archival storage.

11T55

In December, the PDP-11T55 was announced. It is a disk-based system which at the time it was announced provided the industry's fastest system performance for FORTRAN "number crunching" computational and control applications. Major components of the 11T55 include the 11T55 processor with either 16K or 32K words of bipolar memory. CPU instruction execution and memory cycle time are both 300 nanoseconds. It has a new and exceptionally fast floating point processor, the FP11-C, doubling the performance of the FP11-B. Two RK05 DECPACK moving-head disk drives—2.4 Byte capacity per drive.

The 11T55 is a redesigned 11/45 processor with some 11/70 features, 32K parity bipolar memory and the capability of accepting the FP11-C floating point unit. When memory management is off, this combination—bipolar memory and FP11-C—results in the fastest PDP-11 computer ever made up to this time. The 11/55 outperforms all PDP-11s in FORTRAN "number crunching" applications.

THE PDP-8/A 600 SERIES

In April, the "fast" PDP-8/A 600 Series was announced as a replacement for the PDP-8/E, 8/F, and 8/M. The "fast" 8/A has the following features: efficient packaging, 8/E Speed-1.2 μsec., utilizes 8/A Core Memories, less expensive than 8/E's and 8/M's, expansion capability beyond basic box, hardware multiply/divide available as an option, 12 slot and 20 slot OMNIBUS models.

PDP-11F34

The PDP-11F34 is a standard system featuring an 11/34 processor with 16K words of memory, memory management, bootstrap and line clock, dual-drive RX11-B subsystem, and LA36 terminal and control. It supplies greater functionality than the PDP-11F05/10.

GT43

The GT43 is a graphic display terminal combining the power and performance of the 11/34-DM processor and the interactive graphics of the VT11 graphics display subsystem. The GT43 is designed for graphic terminal work in conjunction with a host computer, but with the features of the 11/34-DM, the GT43 can easily be expanded into a stand-alone configuration.

RP05 and RP06 DISK DRIVES

In May, DIGITAL widened its lead in the minicomputer market with two new members of the RP family. The RP05 is a 100 million byte drive that can be field upgraded to the double capacity RP06 unit. The RP05 and RP06 have the same high level of performance and broad range of features as the RP04. The two utilize the same RP04 controllers, and all three disk drives can be intermixed on a single PDP-11 controller.

RK05F DISK DRIVE

The introduction of the double capacity RK05F significantly increased the competitiveness of DIGITAL's entry level disk products which are key options for the PDP-8 and PDP-11 computer systems. The RK05F is essentially identical to the RK05J except that it has twice the track density and a non-removable media. Formatted capacity on the PDP-11 is 5.0 million bytes; on the PDP-8, the formatted capacity is 6.64 million bytes.

THE VT71/T TERMINAL

The VT71/T is a desk top, LSI-11 based video display terminal with a 15" diagonal, non-glare screen capable of displaying up to 24 lines of 80 characters. The keyboard offers standard typewriter layout plus two color-coded, 18-key function pads to the right of the keyboard for text editing and copy management functions. A row of 16 keys designed for user-designed, single or multiple function execution, is located above the typewriter layout.

RSX-11M/2780

The release of RSX-11M/2780 nearly completed the PDP-11 family of 2780 products and provided computer-to-computer communications for the PDP-11, PDP-8, and DECsystem-10. The RSX-11M/2780 can transfer files over synchronous data links to and from the above mentioned systems.

FORTRAN/RSTS-E

In October, FORTRAN/RSTS-E was announced. It is an extended, optimizing FORTRAN IV system which operates in interactive or batch mode under the RSTS/E executive. FORTRAN/RSTS-E is a compatible member of the PDP-11 FORTRAN IV family which is available on the RT-11, RSX-11M, RSX-11D, and IAS operating systems for the PDP-11.

NEW VERSION OF EDUSYSTEM 20, 25

New versions of EDUSYSTEM 20 and 25 software were developed, tested, and submitted for distribution.

EDUSYSTEM 50 (TSS/8)

The Education Products Group announced the final release of V8.24 of the EDUSYSTEM 50 (TSS/8) Time-sharing Monitor. New device handlers were added for CR8/F(CM8/F) and RK8E hardware. A new program was written to perform data transfers between all TSS/8 devices in many different formats including OS/8 DEC-tapes which may be read and written in reverse and forward directions.

FOCAL UNDER RT-11

FOCAL-11 (FOrmula CALculator) is a powerful, interactive, high-level programming language designed for scientists who require an easy-to-learn-and-use, Real-Time language. FOCAL provides both data acquisition and experiment control, as well as data analysis capabilities. FOCAL utilizes the extensive resources of RT-11 for program and data storage. Both Chaining and Overlay capabilities allow the user to write very large programs. FOCAL/RT-11 will operate with a minimum of 12K memory (16K recommended).

ASSIST-11 DIRECTORY ASSISTANCE SYSTEM

ASSIST-11 is a Directory Assistance System designed to provide operators with computerized access to as many as twenty million subscriber listings without referring to printed directories and addenda. Requests for directory information are entered by the operator on a CRT display with a response occurring in seconds with matching entries in telephone directory format.

ASSIST-11 is an application program based on a PDP-11 running RSTS/E which supports a number of operator stations equipped with VT52 displays. It includes all necessary facilities for simultaneous inquiries and maintenance of the directory data base.

COS 310/2780 EMULATION FOR DS 310

In November, COS 310/2780 RDCP software was announced. The software product which is offered on the Datasystem 310 permits batch communications to an IBM 360 or 370 Host system over print or dial-up communication facilities. With this capability the Datasystem(s) can be installed to meet the day-to-day application needs of the Corporation's remote location and communicate summary information to a central location to meet the needs of central control and reporting information. The package also permits communications between two Datasystems.

RT-11/2780

RT-11/2780 runs in background or foreground, but background operation requires that any foreground task be polite, getting out of the way often enough to allow the 2780 to process the protocol. Speeds are up to 4800 baud.

PDL/RT-11

The Medical Product Line announced that the Programmable Data Logger (PDL) will be offered under RT-11/MU BASIC. PDL is a hardware/software system that was designed to log data from 15 clinical instruments while simultaneously enabling the user to develop or run other application programs written in BASIC. PDL now does all this under RT-11 running on either dual floppies or dual disks.

CPL FOR DECSYSTEM-10 AND DECSYSTEM-20

CPL (Conversational Programming Language) is an interpreter which supports a subset of the ANS-1976 PL/I language. It features source-code debugging and immediate mode.

REMOTE-11

REMOTE-11 (Real-time Multiprocessor Oriented Editor for PDP-11) is a software product that solves real-time laboratory problems through the use of computer networks. A REMOTE-11 configuration is a number of small satellites which are connected to a larger disk-based RT-11 host system.

CTS-500/E DATA MANAGEMENT SERVICES 500

DMS provides BASIC-PLUS application programs with generalized data file management facilities for organizing and processing data stored in indexed file structures. By utilizing function calls in user level source language, application programs determine file access modes and input/output operations. Interfaces to the RSTS/E file System, direct access device input/output, and program data buffering are controlled by DMS-500 software.

FOCAL/MPS

In April, came the announcement that FOCAL was now available on the MPS microprocessor. FOCAL programs can now be run on a wide variety of Digital machines, from the low-cost MPS to the PDP-8, PDP-11, and PDP-15.

PDP-15/XVM

In April, the Large Computer Group announced a new product for PL15 Installed Base business:

MULTIACCESS ("MAX")

a true multiuser version of XVM/RSX for either PDP-15 or XVM systems. Because it is based on XVM/RSX, Multiaccess provides a broad range of problem-solving capabilities in a single system, all usable at the same time: multiuser, on-line development/execution of FORTRAN/MACRO programs; multitask, real-time instrument data collection/control; and FORTRAN-supported, multi-station, GT15, high-performance, on-line batch.

BASIC-11 IAS/RSX VERSION 2.0

BASIC-11 Version 2.0 is a conversational programming language which uses simple English-type statements and familiar mathematical notations to perform an operation. BASIC-11 Version 2.0 includes the following extensions to BASIC Version 1.0: more user-defined functions that return integer numeric values and that return a string value; virtual arrays will provide the facility to process arrays larger than available core storage; a call facility which provides the ability to call sub-routines from BASIC-11 programs; and Version 2.0 will include full integer support with integers being single words containing values in the range —32768 to 32767.

RPG II

In May, the Business Products Group announced CTS-500/E RPG II. CTS-500/E RPG II has been developed for the System/3 Model 10 user who wishes to develop multiuser/interactive type applications in BASIC-PLUS.

INDUSTRIAL BASIC/RT-11

Industrial BASIC/RT-11 consists of BASIC/RT-11 together with CALLable assembler routines for handling real-time events. Industrial BASIC/RT-11 provides extensive support for: one or more multiple (up to a maximum of 12) local Industrial Control Subsystems for the PDP-11 (ICS11) including analog inputs, analog outputs, sense and interrupt digital inputs, counter inputs, counter outputs, digital outputs, and one shot outputs; one or multiple AR11 real-time analog subsystems for the PDP-11 (up to a maximum of 12); one or multiple DR11-K general device interface subsystems for the PDP-11 (up to a maximum of 16); one or multiple DRS11/DSS11 digital I/O subsystems for the PDP-11 (up to a maximum combination of 16); Clock-driven functions to provide internal timing and utility for error handling, alarm notification and initialization. Either the ICS (Industrial Control Subsystem) or a combination of AR11, DR11K, DRS/DSS is supported as an I/O subsystem for a PDP-11.

IAS V1.1

In June, IAS V1.1 was announced as a balanced system that delivers compute-power efficiently to interactive, batch, and real-time tasks in any mix, on demand, when and where it is needed.

RMS-11/DBMS-11

In June, two new data services products, RMS-11 and DBMS-11, were announced. RMS-11 (**R**ecord **M**anagement **S**ervices) adds important capabilities at a level above that of traditional file management services. DBMS-11 (**D**ata **B**ase **M**anagement **S**ystem) as a comprehensive CODASYL data base management system extends the upper range of DIGITAL's data services software offerings. It provides powerful and sophisticated data base management capabilities.

DATASYSTEM 350 SERIES OF SMALL BUSINESS TIME SHARING SYSTEMS

In July, the Business Products Group announced the availability of timesharing to the user of small business computers. The Datasystem 350 Series is a family of upward compatible PDP-11/10 based systems which come in three basic configurations: a floppy disk-based system called the DS352, an RK05 based system called the DS354, and an RPR02 based system called the DS356. The Datasystem 350 series, a combination of PDP-11 hardware and an operating system called COS-350, allows up to four users to simultaneously execute commercial programs written in the DIBOL-11 language.

11T35

In September, an exciting new standard in disk-based systems was announced—the 11T35.

POWER MANAGEMENT SYSTEMS

In a move to help large users of electrical power to reduce costs, Digital's Power Management Systems were introduced to help decrease power bills by reducing both peak power demand requirements and total energy consumption. Early in the year the first Power Management application software product had been announced. That product was applied in a variety of market areas, including food processing, textiles, newspaper printing, and electrical equipment manufacturing. Customers experienced shorter paybacks than originally expected and purchased additional systems.

The Power Management applications software was updated to run on less expensive, memory-based systems. The software was combined with Standard Industrial Systems to form a series of Power Management Systems offering a variety of capabilities. The three systems are the Power Management 301, 501, and 701 Systems.

System/301—The 301 is a full power management system especially suited for applications where it is dedicated to Power Management activities.

System/501—The 501 includes all the functional features of the Power Management System/301 plus the extended capability to have user-written software tasks added or to have the applications software modified.

System/701 includes all the functional features of systems 301 and 501. As a higher level system, it allows more sophisticated user-written software to be added.

VS60, GT62 HIGH PERFORMANCE GRAPHICS

In November 1975, Graphic Systems announced the VS60 and the GT62, two new high performance graphics display options. The VS60-AA(AB) is a UNIBUS peripheral which can be configured with any PDP-11; it executes a superset of the VT11 instruction set. The GT62 is a terminal configuration based on the VS60 and a PDP-11/10. With the introduction of the 11/34, the GT62 received a CPU upgrade making the GT62 an even more powerful graphics terminal.

THE SYSTEM 800

As a result of greatly increased interest in desk mounted minisystems, the OEM group responded to requests for a similar product by announcing the MS800 series. To enhance the small system capability of this OEM offering, OS/8 operating system is included as standard. This package meets the needs of OEM customers who require an intelligent terminal for applications in such fields as security systems, inventory control, and laboratory analysis where the computer system must be styled and engineered for a commercial environment.

DEC DATASYSTEM 535-E

The Business Products Group announced a new, low cost, bundled DATASYSTEM 535 based on a low cost 11/40 system with two RK05's. The DS535-E is packaged in two short Datasystem cabinets and has three SPC slots and three SU expansion spaces.

MU/11V03

In December, the Educational Products Group announced the MU/11V03. It is LSI-11, 4 user based system designed specifically for the classroom, at a price of less than $5,000 per terminal. A choice of FORTRAN IV, BASIC, and APL programming languages are offered to meet the needs of all educational users. A graphics terminal with easy-to-use supporting software is available.

GT-46 STANDALONE GRAPHIC SYSTEM

In February, Graphic Systems announced an upgraded version of the popular GT44 graphic display system. With the introduction of the 11/34 processor, the 11/34 was phased into the GT46 configuration, thus presenting the market with a more cost effective graphic system.

PDP-11/34 SYSTEMS

In February, the PDP-11/34 was announced. It supplies computing power equivalent (± 10%) to that of the PDP-11/35 or PDP-11/40. New packaging densities, made possible by the use of a new series of back-panels, enables the 5¼" 11/34 CPU chassis to accommodate up to 64K words of MOS memory and the 10½" 11/34 CPU chassis to accommodate up to 128 words at MOS memory.

The PDP-11/34 is a standard system featuring an 11/34 processor with 32K words of memory, memory management, bootstrap and clock, a dual-drive RK11/RK05 subsystem, and LA36 terminal control.

PDP-11 FORTRAN SYSTEMS

In March, announcement was made of the PDP-11 FORTRAN System Family, an idea which evolved out of the greater emphasis on FORTRAN throughout the minicomputer marketplace. Four optionally-configured system products were developed to compete in all segments of the marketplace.

- the 11V03 low entry system—our initial system offering with the best price/performance in the industry. It is optimized for single user FORTRAN IV with RT-11 Real-Time Foreground/Background System.

- the 11T55—DIGITAL's fastest FORTRAN system. Its 32K bipolar memory, FP11-C floating point option and FORTRAN IV-PLUS will win all computational benchmarks requiring 32K words of memory. Program sizes larger than 32K require the 11/70 for optimum performance due to the 32K bipolar memory limit on the 11/55.

- the 11T34—maximum performance in the mid-range, and our low end offering with memory management and cartridge disk. This includes FORTRAN IV with RSX-11M for high performance multi-programming.

- the 11/70 with IAS—our top FORTRAN System performer for greater than 32K memory, high I/O bandwidth multimoded operating system, and FORTRAN IV-PLUS.

DECEDIT

In April, the Graphic Arts Group announced DECedit, a system which offers the user up to 32 interactive text editing and input CRT terminals for story creation, editing, and data management. DECedit represents the fourth module of a line of PDP-8/E based products designed for news and text processing in the Graphic Arts marketplace. Each module is capable of standalone operations or interactive connection to other modules to form distributive processing networks. Other modules include the Graphic Arts' DECset-8000, DECwire-8000, and TABS-8 Systems.

DECSYSTEM-20

The DECSYSTEM-2040 is a general purpose timesharing and batch system. The hardware is based on a non-cache KL20 CPU, 64-256K 36-bit words of core memory, 1-8 RP04 moving head disk drives, 1-8 TU45 tapes, a line printer (300 or 1200 LPM), a card reader (300 or 1200 CPM), and 8-64 terminal lines. The software is based on TOPS-20, a new virtual memory operating system designed for the DECSYSTEM-20. The TOPS-20 software supports concurrent interactive timesharing and multistream batch, with a variety of unbundled higher level language compilers and application tools available (FORTRAN, COBOL, BASIC, ALGOL, CPL, APL, and Data Base Management). Each higher level language has its own specific interactive debugger. The operating system provides a demand page user address space (256K 36-bit words) as well as many system calls to facilitate on-line data base applications and transaction processing applications. The DECSYSTEM-20 offers large scale general purpose system software to do efficient interactive timesharing and batch.

DS350 11/34 PACKAGED SYSTEMS

In April, the PDP-11/34 was introduced into the DS350 family. This added significant configuration flexibility and expansion capability.

DATASYSTEM 534 PACKAGED SYSTEMS

In April, Business Products announced its newest member to the DATASYSTEM 500 family—the DATASYSTEM 534. With equivalent computing power (±10%) of the PDP-11/40, the DS534 will serve as a direct product replacement for the DS530, DS535, and DS540 DATASYSTEM models.

DEC DATASYSTEM 530

The DEC DATASYSTEM 530 (D530) is a growth-oriented, business computer system for on-line transaction processing. Based on DIGITAL's field-proven PDP-11/34 central processor and the Commercial Transaction System—500 (CTS-500) operating software, the D530 is one of several compatible Datasystem family models offered by the Business Products Group, representing a mid-range capability. It is equipped to handle multiple-task applications in an interactive terminal user environment with background batch processing.

System highlights include large capacity memory, a wide selection of high performance peripherals, disk and magnetic tape mass storage subsystems, a comprehensive set of communications options, and a RSTS/E based commercial transaction operating system (CTS-500) which provides complete data/record management services, a full set of utility programs, and multiple language support.

Other operating systems which may be optionally implemented on the D530 are CDMS-500, DIGITAL's Commercial Data Management System; and RSX-11M, DIGITAL's Real-Time Operating System.

DECSYSTEM 1088 AND DECSYSTEM DUAL 1080

In May, the Business Products Group announced two new systems which were the most powerful ever manufactured by DIGITAL: the DECsystem-1088 and the DECsystem DUAL 1080. The DECsystem-1088 is a new high performance product extension of the DECsystem-1088.

The DUAL 1080 offers the capability of two complete, independent systems with the ability to switch key subsystems into a single configuration in the event of component failure.

DEC DATASYSTEM 570

The DEC DATASYSTEM 570 (D570) is a general-purpose business computer system designed to provide multifunction capabilities for on-line data processing in a simultaneous, interactive transaction processing and batch environment. As the largest member of the Datasystem family offered by the Business Products Group, the D570 supports up to 63 terminal users running under DIGITAL's PDP-11/70 central processing unit. The Commercial Transaction System—500 (CTS-500), a RSTS/E based operating system, is the primary software run on the D570.

Cost-effective systems level performance is achieved through a full range of system features including: large capacity parity memory and high speed cache memory, video and hard copy terminals, various speed line printers and card readers, high speed disk and magnetic tape mass storage subsystems, communications options, and numerous CTS-500 operating system capabilities including multiple language support.

Other optional operating systems supported by the D570 are RSX-11M, DIGITAL's Real-Time Operating System; and IAS, DIGITAL's Interactive Application System.

WORD PROCESSING 310W

DIGITAL entered the fast-growing word processing market with the announcement of the WPS-8. The WPS-8 was the first in a series of products to address the needs of sophisticated users of text editing equipment. WPS-8 is offered as an adjunct to the DEC Datasystem-310 or other appropriately configured PDP-8 systems. WPS-8 is a stand-alone, single terminal, single user word processing system.

FINANCIAL SUMMARY

FISCAL YEAR	1976
Total Operating Revenues	$736,288,000
Income Before Income Taxes	119,400,000
U.S. & Foreign Income Taxes	46,000,000
Net Income	73,400,000
Total Assets	856,038,000
Current Assets	648,109,000
Current Liabilities	149,126,000
Stockholders Equity	606,045,000
No. of Shares Outstanding at Year End	12,944,000
Net Income Per Share	$5.94
EMPLOYEES AT YEAR END	25,000
SHAREHOLDERS AT YEAR END	17,875

GENERAL

- MILESTONES/FISCAL 1977

HARDWARE

- VT61 AND VT61T
- RK06
- PDP-11S34
- PDP-11S55
- LP14
- PDP-1134A
- LS120 DECWRITER III
- PAPERTAPE READER FOR THE LA36

SOFTWARE

- RSTS/E V6B
- CTS-500
- PEAK-11
- CTS-300 DICAM
- APL-11
- DBMS-11
- DX/RSTS

SYSTEMS

- D537
- DATASYSTEM 357
- DECLAB 11/03 AND DECLAB 11/34
- THE WORD SYSTEM 102
- THE DATASYSTEM 320
- DECSYSTEM-2050
- PDP-11/60
- DPM SYSTEMS
- DECSTATION

FINANCIAL SUMMARY

1977

7/76–6/77

GENERAL MILESTONES/FISCAL 1977

THE GRAPHIC SYSTEMS GROUP

In July, the Graphic Systems Group was formed. Several groups were involved in the formation of this group. They were IPG, OEM, LDP, and ESG. The change of graphic responsibility is a significant and exciting step for DIGITAL. Major advances have been made in graphics hardware technology which have taken advantage of DIGITAL's strengths and have reduced the prices for graphic systems.

PDP-8 PRODUCT LINE

On July 1st, the PDP-8 Product Line was created. The charter of this product line encompasses the sale of PDP-8 based products to both OEM's and End-Users in all Marketplaces. This product line was formed to emphasize our commitment to this product and the important role it plays in our markets. According to one study for FY75, the PDP-8 was the fourth largest Minicomputer Company when treated as a separate group. DIGITAL also has a very strong commitment to the large base of customers represented by over 30,000 PDP-8's installed.

50,000TH LA36

In September, DIGITAL established another milestone in the minicomputer industry when the 50,000th LA36 DECwriter II rolled off the assembly line in Westfield, Massachusetts.

GOVERNMENT INFORMATION SYSTEMS

October 1975—DIGITAL formed the Government Information Systems Product Line to more adequately serve the expanding market within National Governments for DIGITAL's products in the areas of data communications and data processing.

September 1976—The PDP-11 architecture was chosen as the standard computer architecture for fourth generation military applications within the U.S. Government.

November 1976—Under license from Digital Equipment Corporation, Norden, Division of United Technologies, introduced their first militarized PDP-11, the PDP-11/34M. With this announcement, military customers now had available for the first time a computer system which would operate in hostile environments that were completely compatible with commercially available computers, thus providing significant cost savings, particularly in the area of common software development.

January 1977—DIGITAL selected as the computer supplier for the Autodin II system. This system will provide a worldwide communication network linking all military bases of the U.S. Department of Defense.

1000TH 11/70 DELIVERED

In January, the Corporation announced the delivery of the 1000th PDP-11/70. The PDP-11/70, the most powerful member of the PDP-11 family, is proving to be a great success for DIGITAL. PDP-11/70 systems have been installed in such diverse applications as banking, factory data collection, education, research, telephone switching, insurance, government information systems, and transportation.

LARGE COMPUTER GROUP REORGANIZES INTO INDEPENDENT MARKET-ORIENTED PRODUCT LINES

In January, the Large Computer Group reorganized into a number of independent, market-oriented product lines. This segmenting of our former product organization into individual market groups is consistent with DIGITAL's overall structure. It allows focus on applications and markets of greatest growth potential, makes for easier interaction with DIGITAL market-oriented product lines, and will facilitate the growth of large computer sales.

HARDWARE 1977

VT61 AND VT61T

The VT61 and the VT61T (Typeset version) are buffered display terminals. The VT61 is a general purpose, high-end display terminal.

PDP-11S34

The 11S34 is an 11/34 packaged system with a dual RK06 disk system. It offered a 28 Megabyte disk system in a very competitive price range. The basic 11S34 includes a PDP-11/34-LM (or MM), Controller for up to eight RK06 drives (RK611), dual RK06 disk drives in separate pedestal cabinets, LA36 DECwriter, and System cabinet (H960-CA).

RK06

In August, DIGITAL announced a medium capacity disk drive designed for the small to mid-range PDP-11 configurations. It features a storage capacity of 14 million bytes in a compact cartridge design and uses technology similar to the RP disk drive family to provide reliability and high performance. A completely new disk cartridge, the RK06K was designed for the RK06 for high reliability and convenience. The RK06 is a medium capacity storage subsystem and fits between the RK05 and the RP families.

PDP-11S55

In September, the PDP-11S55 was announced. The 11S55 is a PDP-11/55 based computer system and consists of the following components: an 11/55, 32K byte bipolar plus 32K byte core memory; an FP11-C, the industry's fastest floating point processor with 6.75 μsec. double precision divide; an RK611, 14M byte disk cartridge drive and controller; an RK06, additional free standing 14M byte disk cartridge drive for a total of 28M bytes of storage; and two H960-D cabinets.

PDP-1134A

In March, the Corporation announced the 1977 model of the PDP-11/34—the PDP-1134A. It contains several enhancements which affect configuration and add-on rules. An 1134A is an 11/34 with the following changes: the 2-board 1134 CPU has been modified to directly interface with the FP11-A floating point processor instead of requiring the FP11-AU processor upgrade; the +5 volt regulators have been enhanced to 32 amps and reliability has been improved; chassis and power distribution have been changed to distribute the additional +5 volt power; and, the bootstrap has been revised to the M9301-YF version which supports the RK06.

LP14

In response to the demand for a more competitive, high speed line printer for PDP-11 systems, a totally new printer was announced in March, the LP14. The LP14 is available in two models—900 lines per minute with a 64 character drum, and 660 lines per minute with a 96 character drum. It has all the important features required of a high speed line printer for data centers and business data processing.

LS120 DECWRITER III

The LS120 DECWRITER III was announced as a low-cost, interactive hard copy keyboard terminal designed for operation at 1200 baud. The LS120 offers all the features of the LA36 and LA180 plus additional forms handling and communications capabilities.

PAPERTAPE READER FOR THE LA36

The PRS01 is a small portable papertape reader that connects into the serial line of a system console or terminal. The reader provides a convenient and inexpensive method of loading papertapes using the keyboard device codes of the terminal. It is designed primarily for loading maintenance and diagnostic programs. The reader produces a 20mA serial asynchronous signal; it can be interconnected to a console device or terminal (by means of a "Y" cable, standard with the PRS01), or to the current loop input of an approved interface if no console device is available.

SOFTWARE

RSTS/E V6B

In February, RSTS/E V6B was shipped. It is a PDP-11 based, multi-language timesharing system with features which also make it attractive as a base for multiterminal applications systems. RSTS/E V6B is an updated and enhanced version of the RSTS/E operating system.

CTS-500

In August, the Commercial Products Group announced major enhancements to field-proven software supported by new hardware packaged in the more attractive corporate cabinets. Major highlights of this product included a change of the name CTS-500/E (Commercial Timesharing System/Extended) to CTS-500 (Commercial Transaction System). This name change reflects the new transaction processing enhancements to the BASIC-PLUS language availability of DIBOL-11 with DECFORM on CTS-500 (RSTS/E V6B based) software with a coherent model number scheme. These new features offered a significant increase in the features, functions, and benefits of CTS-500/E.

PEAK-11

In October, Laboratory Data Products announced PEAK-11 Version 1, a unique LDP product. PEAK-11 provides more of the "tools" needed by the LDP customer for acquiring and analyzing data from analytical instrumentation than from previous LDP products. PEAK-11 is a hardware/software peak processing system using the flexible RT-11 Foreground/Background Operating System and MU BASIC for background programming and communication with the foreground PEAK-11 software. A variety of laboratory instruments, including gas chromatographs, liquid chromatographs, and auto analyzers, can be interfaced to the PEAK-11 system for data acquisition and peak processing.

CTS-300 DICAM

CTS-300 Datasystem Interactive Communications Access Method, a software package which runs under the CTS-300 operating system, permits DIBOL application programs to exchange data with a 360/370 HOST system on an interactive basis. The interactive capacity is achieved by using the same communication procedures as the 3271 remote keyboard display and printer controller, which the 360/370 supports as a standard option. This approach virtually assures compatibility.

APL-11

Announcement was made in December of another programming language to the PDP-11 family. APL-11 is a mathematically-oriented language especially suitable for handling numeric and character array-structured data, but flexible enough to solve problems in text handling and commercial data processing.

DBMS-11

In January, DBMS-11 (Data Base Management System) was released after a successful period of field testing. DBMS-11 is the first CODASYL DBMS implementation for a minicomputer in the industry.

DX/RSTS

In April, DIGITAL announced DX/RSTS, a software utility that allows the RSTS/E customer to enjoy "shared use" of the large capacity disk storage units and high speed line printers, along with the powerful text editing and record processing features of DIGITAL's word processing systems. DX/RSTS enables PDP-8 based Word Processing systems to be "linked" to PDP-11 based RSTS/E timesharing systems. WS-100 single terminal and WS-102 multiterminal users with communications option can now transmit and store documents at the respective "host" system to act as a document data bank, storing word processing documents in the larger "host" storage units.

SYSTEMS 1977

DATASYSTEM 357

In September, the Commercial Products Group announced the newest model in the Datasystem 350 family, the Datasystem 357. The Datasystem 357 features the following: RK06 Disks, PDP-11/34 processor with MOS memory. The Datasystem 357 combines the performance of the 11/34 CPU with the field proven reliability and lower cost of MOS memories. The Datasystem 357 also uses new Datasystem cabinets.

D537

In September, the Commercial Products Group announced the DECdatasystem 537. The D537 expanded the saleability of the D530 family series with the inclusion of the RK611/RK06 dual spindle 28M byte storage subsystem. This low capacity rotating storage facility has the same device transfer rate as the RP04, RP05, RP06 based storage systems at a significantly lower price. In addition, compatibility with other D530 addition systems was maintained by use of the 11/34 CPU and the CTS 500/E operating system. This system is mounted in a single corporate Hi-Boy cabinet (H9602) and separately mounted dual RK06 disk drives.

THE WORD SYSTEM 102

In October, DIGITAL announced the introduction of our WORD SYSTEM 102. It has all the power and flexibility of the WS-100 word processing system but with two terminal capability. The new WS102 features an enhanced version of WPS-8, DIGITAL's ready-to-use word processing software.

DECLAB 11/03 AND DECLAB 11/34

In October, the Laboratory Data Products Group announced the newest members of the DECLAB family. The range of systems offered, from the low-cost DECLAB 11/03 to the high performance DECLAB 11/34, gave our customers the ability to truely match a DECLAB system to both their laboratory computer requirements and their budget.

DECLAB 11/03

The DECLAB-11/03 introduces the LSI-11 in a complete, lower cost, laboratory data acquisition system. The DECLAB-11/03 systems with their hardware fixed and floating-point arithmetic unit have the computational powers of much more expensive computers. Combining the computational power with the A/D converters, D/A convertors and DIGITAL I/O, the DECLAB-11/03 offers a low-cost solution to many laboratory applications.

DECLAB-11/34

With the introduction of the DECLAB-11/34, the tradition of DIGITAL's leadership in computers for laboratory applications is continued. The range of DECLAB-11/34s, from the inexpensive yet powerful floppy-based DECLAB-11/34-E with its graphics display capabilities can meet a variety of laboratory needs. These DECLABs are expandable systems, by adding such options as the powerful FP11-AU, floating point processor or AM11-K 48-channel expansion multiplexer for the AD11-K. The DECLAB-11/34 can expand as the application expands.

THE DATASYSTEM 320

In November, DIGITAL's Commercial Products Group announced the Datasystem 320, an entry system for both OEM's and End-user's that can grow with a customer's needs and take full advantage of a company's commercially-oriented software. This represents a PDP-11 based entry system for small businesses and distributed networks, and also indicates DIGITAL's commitment to the commercial marketplace. The Datasystem 320 brings the company's leading technology, the LSI-11 microprocessor, and a DIBOL Instruction Set, to the realm of business applications for the first time. The DEC Datasystem 320 builds upon the LSI-11 processor to provide two new models, D322 and D324.

The Datasystem 322 is a floppy diskette based system with 32K bytes of memory packaged in the same desk as the DS310 and using a VT52 CRT. It can be configured with more memory, additional terminals, more mass storage, and a variety of printers.

The Datasystem 324, also using an LSI-11, is an RK05 disk based system. Offered in the new Datasystem cabinets, the basic system consists of 32K bytes of memory, a VT52, and an RK05J and RK05F. It, too, can have more memory, more terminals, more mass storage, and a variety of printers.

The DEC Datasystem 320 offers exceptional performance in the commercial data processing environment. This is due in large part to the inclusion of a DIBOL Instruction Set, referred to as DIS. It consists of a series of hardware-executed instructions micro-programmed in read-only memory. The instruction set is composed of three groups of command types: character string moves, searches, and decimal arithmetic.

DECSYSTEM-2050

In November, DIGITAL announced the DECSYSTEM-2050, second member of the DECSYSTEM-20 family. The system features cache memory and the TOPS-20 high performance virtual memory environment that provides an impressive multi-tasking, multi-programming capability to support timesharing, transaction processing, and multi-stream batch processing. The system can support up to 128 asynchronous communication lines, features 3.2 billion characters of on-line disk storage, and will handle the full line of DECSYSTEM-20 peripheral subsystems.

DPM SYSTEMS

Introduced in March 1977 by the Industrial Products Group, Distributed Plant Management (DPM) systems integrate factory data management and input/output (I/O) processing into a single, efficient system for managing production resources. The DPM concept combines on-line processing, real-time data acquisition, microprocessor control, distributed computing, and hierarchical computer systems—all integrated through one low-cost communication link.

DPM's factory data management subsystem collects data from machines and employees with the interactive RT801, 803, and 805 terminals. A DPM50 I/O subsystem monitors machines and processes with real-time analog and digital interfaces. Sharing a common set of new I/O functional modules, the subsystem can function as a distributed (DPM50) or a stand-alone (IP300) element, utilizing its LSI-11 microcomputer to put intelligence at the task site. The DECdataway® links all system elements inexpensively and reliably to the PDP-11/34 or 11/70 system host.

PDP-11/60

In March, DIGITAL announced a new mid-range price/performance system, the PDP-11/60. The 11/60 offers more features for significant performance and reliability than any other computer in its class. Designed around the proven architecture of the UNIBUS, the PDP-11/60 offers real-time application as well as multi-user and multi-tasking time-share applications. A combination of unique features are offered by the 11/60 which normally are found in larger, more costly computers or partially implemented on others that are PDP-11 class equivalent. The PDP-11/60 offers user control store features previously unavailable from DIGITAL, as well as several 11/70 class features such as cache memory and RAMP.

DECSTATION

In May, the Corporation announced its newest computer, DECstation, a family of components centered around the VT78 Video Data Processor. This processor is a complete PDP-8 computer system implemented with large scale integration technology so that it could be packaged inside the shell of a display terminal. DECstation is sold as an Intelligent Terminal and as a floppy-based, small system by the PDP-8 and Word Processing groups. Designed for an interactive environment, the primary emphasis is on system capability, hence the large 16Kw(32Kb) memory and the array of I/O controllers.

FINANCIAL SUMMARY

FISCAL YEAR	1977
Total Operating Revenues	$1,058,614,000
Income Before Income Taxes	176,400,000
U.S. & Foreign Income Taxes	67,900,000
Net Income	108,500,000
Total Assets	1,070,432,000
Current Assets	805,021,000
Current Liabilities	230,855,000
Stockholders Equity	735,463,000
No. of Shares Outstanding at Year End	38,990,558
Net Income Per Share	$2.78
EMPLOYEES AT YEAR END	36,000

DIGITAL'S MANUFACTURING CAPABILITY

DIGITAL'S MANUFACTURING CAPABILITY

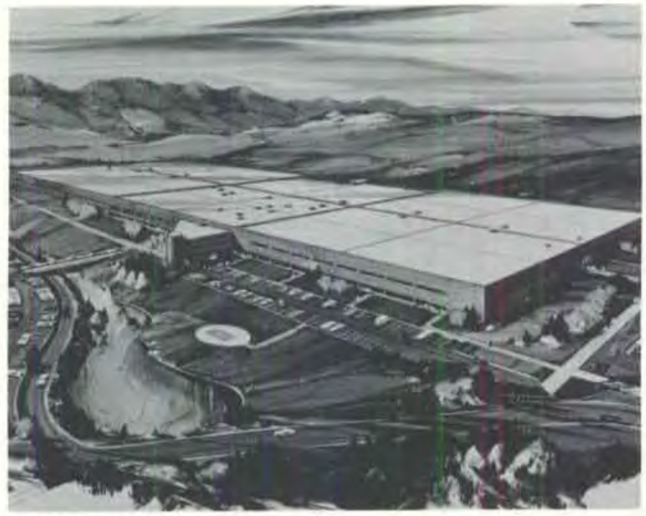
DIGITAL has expanded its manufacturing ability tremendously since its beginnings in the Maynard Mill. Manufacturing facilities now exist world-wide. The following section presents each manufacturing facility and describes its size, the number of personnel, and the products manufactured.

PLANT	ACTIVITY	SIZE/SQ. FT.	NO. OF PEOPLE
Maynard/Acton	Modules, Test Equipment	300K	1200
Puerto Rico:			
San German	Modules	230K	2100
Aquadilla	CPU's	180K	800
Marlboro/ Natick/ Worcester	Electromechanical, Memories, LSI	170K	900
Marlboro	DEC-10	225K	600
Burlington/ Derry	CPU's	150K	450
Salem, NH	Systems, Options	700K	600
Colorado/ Mt. View	Disks, Tapes	110K	300
Springfield	Tapes	200K	800
Albuquerque	Terminals	320K	375
Westfield	Terminals	600K	1900
Phoenix	Terminals	375K	1200
Far East:			
Taiwan	Core Stringing	90K	750
Hong Kong	Modules	120K	1650
Augusta	Options	60K	100
Westminster	Systems	690K	2300
Galway, Ireland	CPU's, Systems	250K	1000
Ayr, Scotland	Systems	80K	150
Kanata, Canada	Logics, Systems	50K	400

MAYNARD

PUERTO RICO

MARLBORO



COLORADO/MT. VIEW

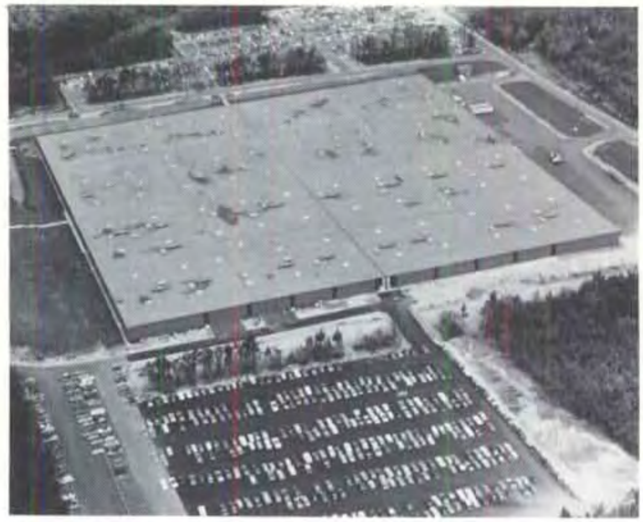
NATICK

SPRINGFIELD

SALEM, N.H.

ALBUQUERQUE

WESTFIELD



WESTMINSTER

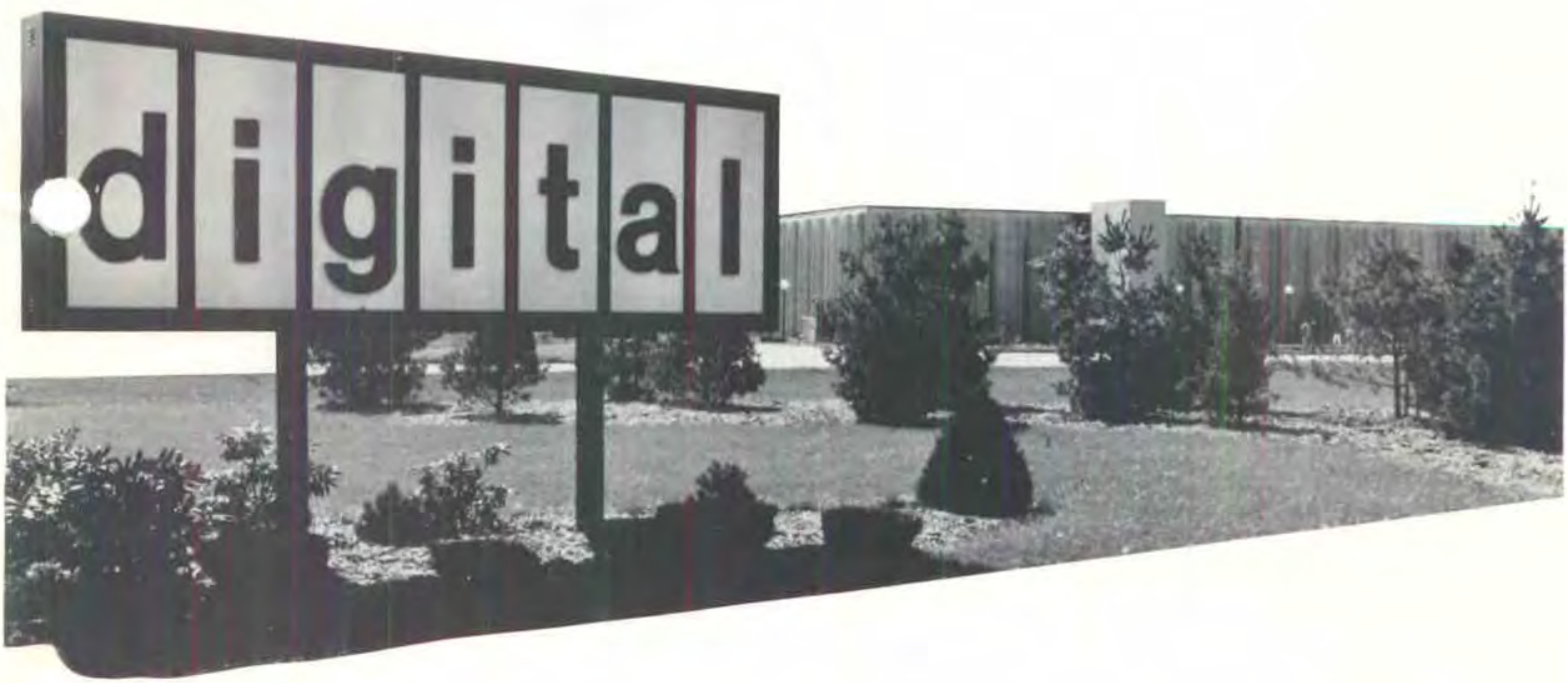
PHOENIX

GALWAY

TAIWAN

KANATA, CANADA

SYSTEM, OPERATING REVENUES AND PRODUCT SUMMARIES



INSTALLED MINICOMPUTER SYSTEMS

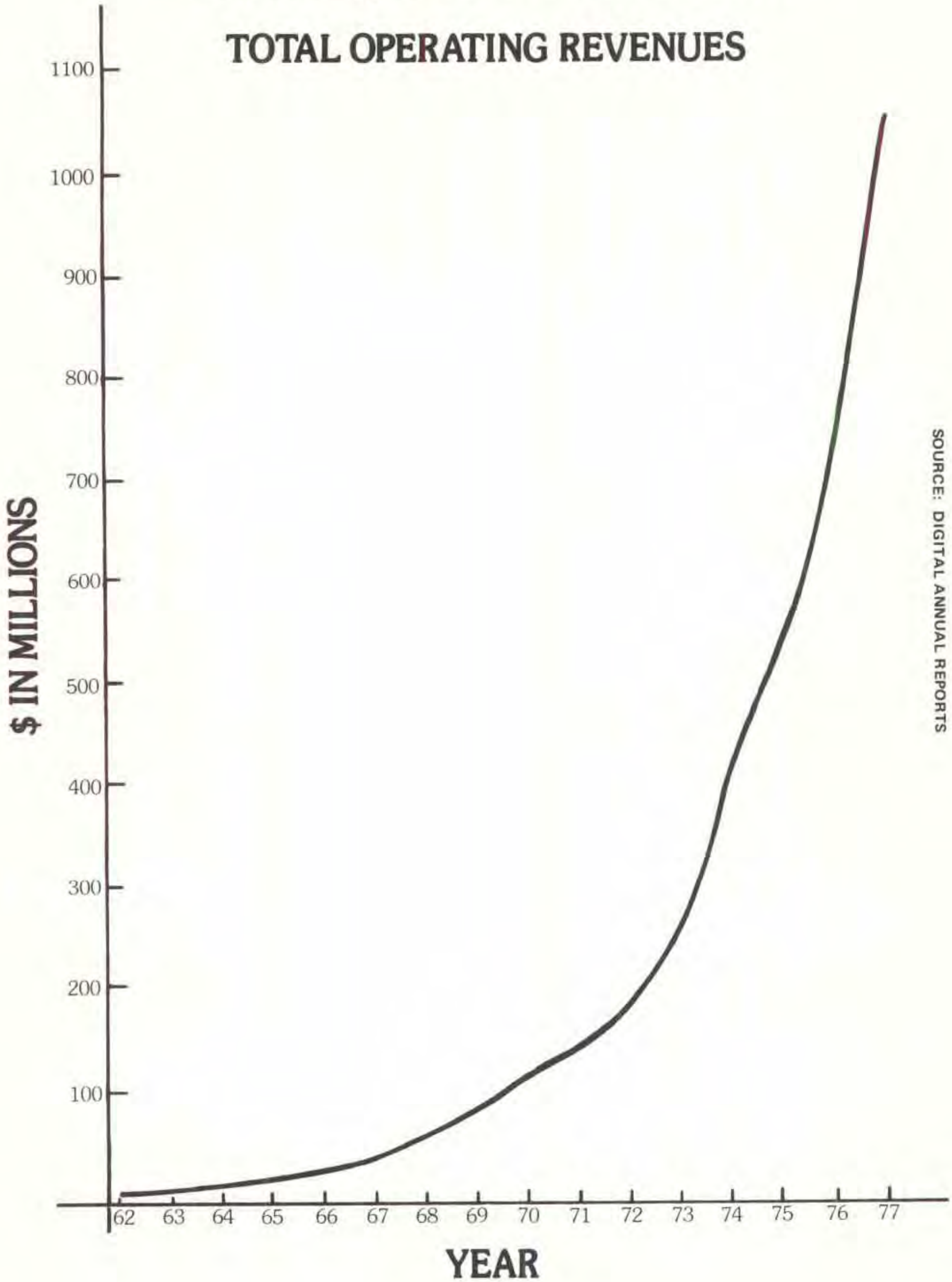
as of January 1, 1977

(Source: International Data Corporation/ EDP Industry Report, 4/22/77)

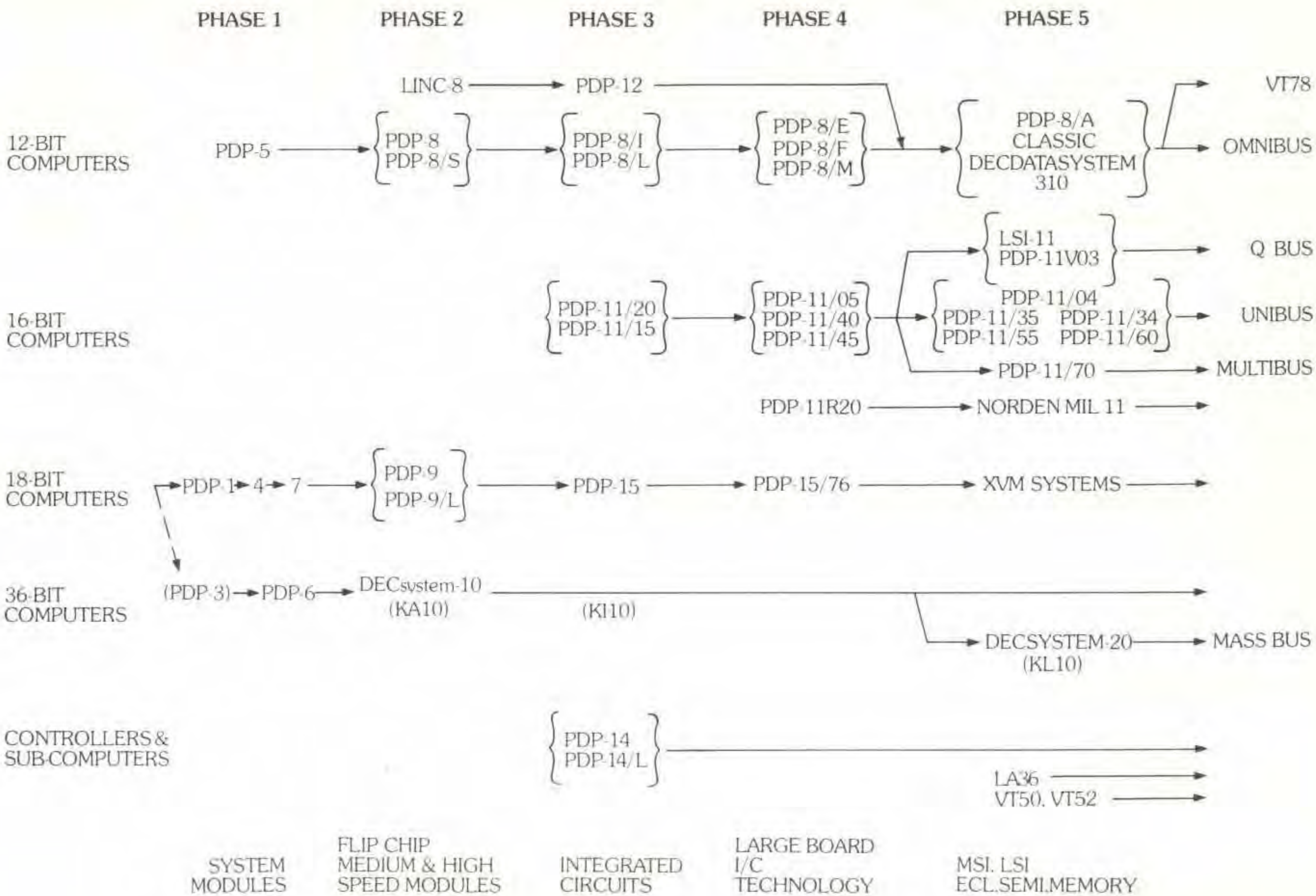
NAME OF MANUFACTURER	COMPUTER MODEL	DATE OF FIRST INSTALLATION	TOTAL NUMBER OF INSTALLATIONS
DIGITAL EQUIPMENT CORP.	PDP-1	11/60	41
	PDP-4	8/62	33
	PDP-5	9/63	90
	PDP-7	11/64	115
	PDP-8,I,L,S	5/65	9,450
	PDP-8A, E, F, M,	4/71	27,550
	PDP-8/LINC	9/66	134
	PDP-9 & 9L	12/66	450
	PDP-11-04, 05, 10, 15, & 20	3/70	24,350
	PDP 11-34, 35, & 40	1/73	8,750
	PDP 11-45, 50, & 55	4/72	3,000
	PDP-12	4/69	765
	PDP-15	2/70	855
	PDP-11/70	7/75	1,100
	LSI-11 & 11/03	6/75	4,750
	SUBTOTAL		81,433

DIGITAL EQUIPMENT CORPORATION

TOTAL OPERATING REVENUES



DEC HARDWARE PRODUCT FAMILIES



digital

DIGITAL EQUIPMENT CORPORATION

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DIGITAL IS...

... A LEADER IN THE COMPUTER INDUSTRY

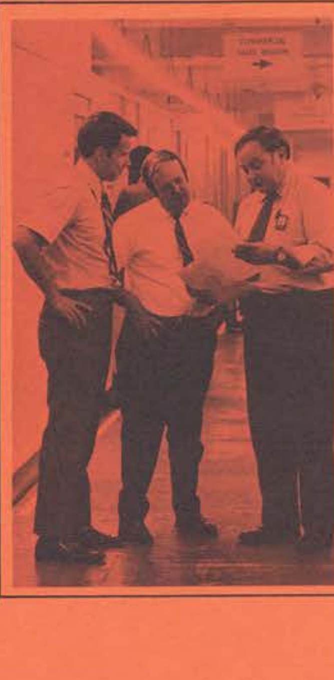
In almost every area — business and commerce, science, medicine, education, entertainment, agriculture, exploration — computers are used to extend and enrich Man's abilities.

And almost daily, new uses for computers are being found; new aspects of human activity made more productive.

Result? The computer industry, relatively new as industries go — has become a major influence in the country's growth — in manufacturing, process and production control, publishing, transportation, medicine, education, and in a host of other key areas. And its influence will increase even further in future years.

Digital Equipment Corporation is unique in the computer industry. Why? Because we invented a whole segment of it. The minicomputer industry. A whole, new concept to the computer industry when we introduced it. A development so effective that it has helped catapult Digital into a position as one of the leaders in the computer industry. In fact:

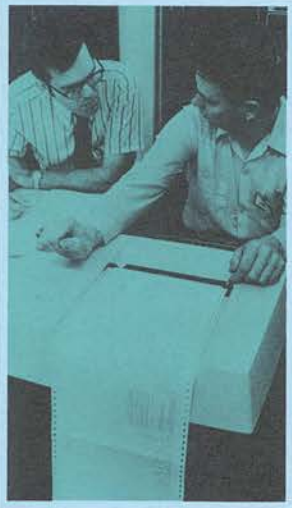
- In terms of number of computer installations, Digital is the second-largest computer company in the world.
- In terms of minicomputers, Digital is not only the leader, but its computers are the standard of the industry.
- In many industries such as metalworking, biomedicine, and typesetting, Digital's computers are the ones that are used most.



- Digital's growing influence has been matched by company growth. We are a worldwide company with offices in Australia, throughout Europe, across Canada, in Japan. And with representatives in Central and South America. And in non-Communist Asia.
- We are financially sound. Digital's sales are in hundred-million-dollar brackets each year. And each year's sales have been higher than the year before. Lots higher. We are listed on the New York Stock Exchange. In the *Fortune* top 1000 companies. Last year, as a matter of fact, we were called the second-fastest growing company in the U.S. The fastest-growing company didn't make computers.

THE OUTLOOK, TODAY AND TOMORROW

The computer industry is already important. Yet as each passing day brings new products and services, and as new uses are found for computers, their influence will become even more substantial. Thus, there are already many exciting and challenging jobs. Jobs at all levels. And in a variety of fields: Manufacturing. Administrative and Clerical.Engineering. Programming. Drafting. Sales. Service. Training. Sales Promotion. Personnel. Public Relations. Marketing. Advertising. Accounting and Finance. A broad spectrum—jobs that concern one of the frontiers of modern technology. Jobs with an exciting future. And jobs that are important.



YOUR OUTLOOK, TODAY AND TOMORROW

Whether you are seeking your first job, or if you've been working for some time, this might be a good time to take a look at your job goals— to evaluate not only your present situation, but where you will be tomorrow. What you will be doing, and whether or not you want "just a job" or whether you want something more.

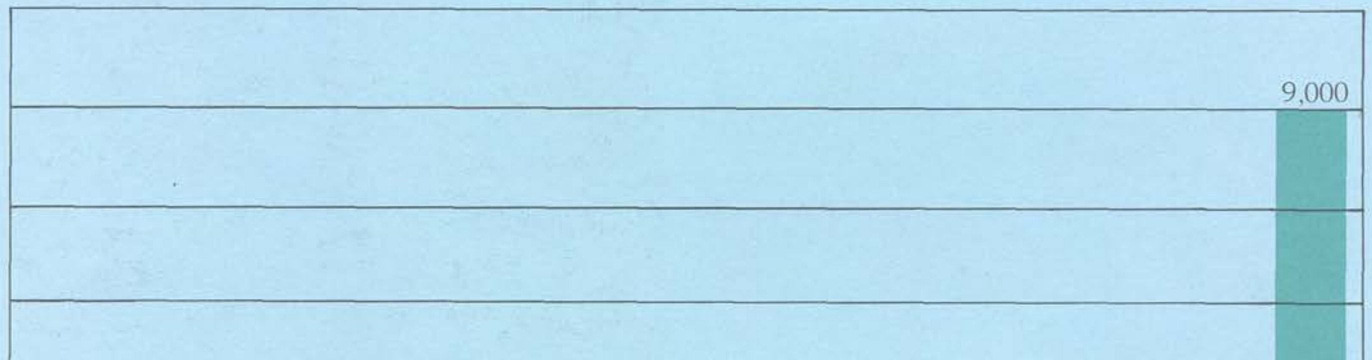
Does what you are doing now satisfy your interests? Is it taking full advantage of your talents? Your aptitudes? And where does it lead? To a dead end? To a job that carefully pigeon-holes you? Limits your growth and activities? Or, does it afford you opportunity for advancement? Increased authorities and responsibilities? Compensation based on abilities? Does your job have a ceiling that you will define as much as your employer does?

While you are considering these things,consider Digital.

WHAT DIGITAL'S ALL ABOUT

Innovation. Freedom. Growth. Excitement. Products that have revolutionized the computer industry. Applications that have pioneered whole new areas of use for computers. Whole new design concepts. The long way we have come since we were founded in 1957. The people that have helped us get to where we are today. That sums us up. Here's what's happened at Digital since we were founded in 1957.

DIGITAL'S GROWTH CURVE IN TERMS OF EMPLOYEES



DIGITAL'S COMPUTERS, AND WHAT THEY DO:

Computer	Introduced	Typical Application	Significance
PDP-1	November 1960	Math. analysis for lab.	Computer power for under $1 million
PDP-4	August 1962	Same	18-bit power at even lower cost
PDP-5	September 1963	Coupled to sci. instrumentation	First minicomputer.
PDP-6	October 1964	Data processing	Digital's 1st large-scale computer
PDP-7	November 1964	Physics analysis	Successor to PDP-4; more power at lower cost
PDP-8	April 1965	Process control	First mass-produced minicomputer
PDP-8/S	September 1966	Numerical Control	First mini at only $10,000. Suitable for OEMs
PDP-8/I	March 1968	Laboratory instruments	Integrated-circuit mini.
PDP-8/L	November 1968	Machine tools	Successor to PDP-8/S; lower cost, faster
PDP-8/E	June 1970	Pollution Monitor	Employs printed-circuit OMNIBUS
PDP-8/M	August 1971	Motion picture animation	OEM PDP-8 using OMNIBUS. Half 8/E size.
PDP-8/F	May 1972	Education	End-user version of PDP-8/M
PDP-9	December 1966	Graphical Analysis	Successor to PDP-7
PDP-9/L	November 1968	Parts inspection	Small version of PDP-9
DECsystem-10	December 1967	Timesharing	Successor to PDP-6; greater power
PDP-11/20	March 1970	Instrumentation Analysis	First DEC 16-bit minicomputer; UNIBUS architecture unique
PDP-11/15	April 1971	Process control	OEM version of PDP-11/20
PDP-11R20	February 1971	Shipboard data gathering	Ruggedized version of PDP-11/20
PDP-11/05	August 1971	Communications	Small OEM member of PDP-11 family
PDP-11/10	June 1972	Materials handling	End-user version of PDP-11/05
PDP-11/40	July 1972	Timesharing	Successor to PDP-11/20; twice the price-performance ratio
PDP-11/45	October 1971	Numerical Analysis	Bridge between minicomputer and medium-scale computer
LINC-8	September 1966	Medical analysis	Computer with dual-processor capabilities
PDP-12	September 1969	Psychology	Successor to LINC-8
PDP-15	February 1961	Medical Records	Successor to PDP-9

Innovation and imagination go hand in hand. Digital's computers and associated products are a direct result of unfettered imaginations, and of creative people not afraid of new ideas. And of people who encourage them, nurture them.

But imagination would be useless without individual freedom — freedom to express the innovative ideas that result in the quality products we manufacture. To further this aim, one of Digital's fundamental practices is to keep an open channel available to every employee; to let each employee have the opportunity to suggest innovative ideas; to avoid the pigeon-hole-classification philosophy common in many other companies. To allow them to grow as their abilities grow and as Digital grows. And Digital has the confidence in its employees to act on the truly innovative suggestions. And to give them the responsibility for implementing them. A confidence that has paid off for the employees, stimulating them in an excitement-charged atmosphere where things get done, and for Digital, increasing the company's leadership role in the computer industry.

All of this — our strengths, our growth, our innovations — has made Digital unique. Unique in the computer industry. Unique to our customers in the many and varied fields where our computers are used. And unique to our employees.

YOU AND US

We've talked about us; let's talk about you. We asked you to consider us while you were considering your future, because we feel we have a lot to offer to those who want more than "just a job." To those who've set their sights on this goal, we offer a lot:

- We offer opportunities as limitless as our future, no matter what your specialty. And on an equal-opportunity basis.
- We offer opportunities for advancement based on demonstrated ability and Digital's policy of promotion from within. Your work is reviewed, your strengths and weaknesses are noted, and from this evaluation, your promotion potential is determined.

In addition to promotion upward, employees have other means of advancement. They are not locked into vertical growth. When employees discover they have a talent and interest other than what they originally joined Digital to do, they have the opportunity to transfer to the areas of their interests and maximum talents. In fact, we encourage it, because we feel employees doing what they find most interesting, and that which they have the greatest talents for, benefits both them and us.

- No matter how our employees wish to advance, we help. With a tuition refund program that allows each employee to increase his job skills. We encourage participation in professional societies; we have an in-house training program for administrative personnel. Most important, we let our employees learn and train on the job.

Digital is highly concerned with the health and welfare of its employees, and offers them an outstanding package of benefits, including:

- Company-paid medical insurance and major-medical insurance.
- And company-paid travel accident insurance.
- We have company-sponsored recreation programs, and programs for income protection and medical insurance for dependents. And a stock purchase plan.

YOUR FUTURE AND OURS

Digital's success has been due to maximizing the role of its employees. Letting them innovate, giving them opportunities to advance. Being a leader in the computer industry—and being a more broadly based company than any other in the minicomputer field—Digital offers a wide variety of jobs. Jobs that are exciting. Jobs that involve our employees participation in the latest happenings. Jobs of all levels, all skills. Jobs with a future.

Perhaps the ideal job for you. Talk it over with us.

For further information, call or write
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(617) 897-5111.

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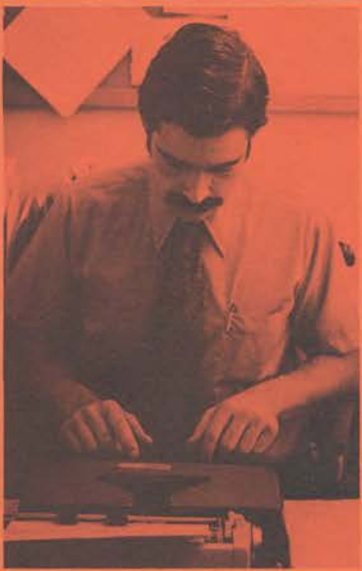

All positions within Digital Equipment Corporation are open for application to men and women regardless of race, national origin, religion or creed.

digital

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PRINTED IN U.S.A. 9801X 01172 2571/K 16 50

engineering handbook

november 1974

office of development
digital equipment corporation
maynard. massachusetts 01754

ENGINEERING HANDBOOK

digital equipment corporation • maynard, massachusetts

1st Printing, November 1974

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CONTENTS

PREFACE

The *Engineering Handbook* is designed to be used primarily by design and project engineers who work under the Office of Development (Central Engineering). It may be useful to other engineers and support people in the company, but second person pronouns (you, your) refer to Office of Development engineers.

Chapter 1, WHY, is intended to give the flavor of the company. Chapter 2, HOW, traces the typical life of a project from concept to installation. Chapter 3, WHO, details the relationships between design and project engineers and the various groups they have to work with.

New people may find the best way to read this book is to read Chapters 1 and 2, and skim Chapter 3. Later on, sections of Chapter 3 can serve as a reference when dealing with particular groups.

CHAPTER 1
WHY

1.1 PHILOSOPHY

Honesty
Not only do we want to be technically honest, but we also want to ensure that the implications of what we say and the impressions we leave are correct. We feel that any commitment to customers or employees must be honored.

Profit
We are a public corporation in which stockholders invest for profit. Success is measured by profit. With success comes the opportunity to grow, the ability to hire talented people, and the satisfaction that comes with meeting goals. We feel that profit is in no way inconsistent with social goals.

Quality
We aspire to be a quality organization performing quality jobs so that we can be proud of our product and our work for years to come.

The product we sell incorporates the engineering, the software, the manufacturing, and the services, which include field service, software support, sales, order processing, training, and manuals.

Responsibility
Plans, which may be rejected until they fit corporate goals or until there is confidence in them, are proposed by managers or teams. The impetus for a plan may come from outside the group making the proposal, but the accepted plan is the responsibility of those who proposed it.

Line Management
We particularly want to be sure that line management jobs are clearly defined. Because many people are dependent on the plans of line managers, it is important that the plans have regular automatic measurements of success built into them. Profit is only one measure of a plan; other measures are customer satisfaction, career advancement for Digital personnel, achievement of long range corporate needs, development of new products, and exploration of new markets. We believe that our commitment to planning assures our freedom to act.

Civic Responsibilities
We are committed as a corporation to take affirmative action to provide equal opportunity for employment and promotion for all persons – regardless of race, color, creed, or sex. We encourage all employees to take responsibility in community, social, and government activities and we will always entertain ideas for corporate or individual (on corporation time) participation in these areas. However, activities involving company time or with company funds may require a formal proposal including ways of regularly measuring progress toward goals.

Environment
As good citizens, we believe we have the responsibility to keep our environment free from pollution.

Customers
We must be honest and straightforward with our customers to be sure not only that they are told the facts concerning our products and services, but also that they understand these facts.

To the best of our ability, we want to be sure that the products we sell solve the needs of our customers. When we sell a product to a customer, we want to be sure the corporation fulfills the obligations we assumed with the sale.

Competitors
We never publicly criticize the competition; we sell by presenting the positive features of our own products. We want to be respectful of all competition and collect and analyze all public information about competitors. When we hire employees from competitors, we should never press them for confidential, competitive information, nor should we use confidential literature they may have taken with them.

Simplicity and Clarity
We want all aspects of Digital to be clear and simple. We want simple products, proposals, and organization, literature that is easy to read and understand, and advertisements that have a simple, obvious message.

We have thousands of employees and many thousands of customers. We have to keep things simple to be sure that we all work together. Our decisions must always consider the impact on the people – both customers and employees – who will be affected by them.

OEMs (Original Equipment Manufacturers)
Standard products are the base of our business. At times, in certain areas, we will develop and invest in software and hardware for special markets. But we should never lose sight of the fact that the base of our business is our standard products.

We are very dependent on sales to OEMs. There are more applications for our products than we could ever develop. In addition, the development of many new fields presents risks that we cannot afford to take. Therefore, we are very dependent on OEMs, and when they take the risks and are clever enough to be successful, we should respect their risks and their effort and neither compete with them nor hurt them otherwise. When our OEMs are in trouble with a customer we should help solve their problem.

End Users
We make products for the end users. If our products do not solve their problems, we have failed in our job. We strive always for good understanding of the end users' needs.

Personnel Development
We encourage employees to develop technical skills, breadth of knowledge, and expertise in a specific area. We also encourage them to develop supervisory and management skills. We believe that individual discipline should be self-generated.

Promotion
We promote people according to performance, considering not only technical ability, but also the ability to get the job done and to take the responsibility that accompanies the job. Ability is measured by attitude and desire to succeed as well as by past results. Performance results are also used to decide whether a person should remain in his or her current job.

Hiring From Customers
We should be exceedingly careful when hiring employees from customers. Sometimes this is reasonable and desirable, but we should do it with caution to be sure that the employee first tells the customer and allows the customer the chance to compete with us.

First Rule
When dealing with a customer, a vendor, or an employee, do what is "right" in each situation.

1.2 STRUCTURES AND PERSONS

Like other large organizations, Digital has a structure that helps us channel our energies. Our structures are abstractions built upon real people. We let the structures survive only so long as they help us get our job done. These are the important things to remember about our corporate structure:

1. It influences the way we work, but it never takes responsibility for what we do; only people can take responsibility.
2. It is there to help get the job done. It works well for things like policy decisions. When ideas and problems are involved, however, people are encouraged to talk with anyone in the organization who should be informed or who can help. Don't let structure bar the way.
3. We always try to push decisions down to the lowest level where all information is available.

One-by-One
In your area of responsibility, your job is to find out what is right, and then do it. Digital's products are used in critical applications where malfunctions can be expensive for our customers, and, in some cases, can cause injury to property and human life. We must focus on decisions that affect these kinds of applications. *You* are the only one who understands your product completely; that is why we focus responsibility on you.

One of the most difficult adjustments at Digital is realizing that you may have little authority over many aspects of your product even though you are responsible for all of it. Hence, it is *not* sufficient to do what is right; you have to convince others of what's right. This is in part a check on your ideas. You should begin to wonder about your decisions when you cannot convince others to work with you. It also forces clarity in your thinking.

Good communication is a very important part of what is right. You *must* understand how your specifications will be interpreted. You must make sure that sales personnel and customers understand the limits of a product's specifications. Malfunction due to misuse by a customer is an acceptable excuse only if our customer can be made aware of that misuse through clear and accurate communication.

Two-by-Two

The two-by-two method for product development is an important new concept for Digital. Essentially, it proposes that every project be managed by a two-person team – one from engineering, and one from manufacturing. Each person is jointly responsible for introducing a new product into production.

Engineering responsibilities include:

- Planning
- Design
- Testing
- Documentation
- Startup (jointly with manufacturing)
- Support of production and field
- Meeting cost goals
- Shipping on schedule

Manufacturing responsibilities include:

- Product introduction plan
- Influence design to ensure manufacturability
- Capacity forecasting
- Volume production – documentation and successful implementation

The principal advantage of the two-by-two concept is the focus of joint responsibility on two people and the granting of a certain amount of freedom to do what is right for a particular product.

The two-by-two concept can have problems:

1. You must avoid using the freedom to re-invent the wheel, i.e., to re-learn lessons previously learned (often the hard way).

2. You may be tempted to go off and do your own thing ignoring the strengths of people with in-depth experience and knowledge in specific areas. This would make the team only as strong as the team members.

Both engineer and manufacturing manager have total project responsibility, but each is subject to existing "business" disciplines and operates within existing charters. Thus, you should involve metals people in metals decisions, module people in module decisions, and so on.

The details of the two-by-two relationship cannot be defined. Our concepts are changing as we gain more experience, and each engineering group and manufacturing facility is different. They make different products and work in different ways.

You can think of the two-by-two concept as a silly management game. If so, it won't succeed any better than any other game. If you really buy into the relationship, however, if you bring honesty, integrity, and love to your partner, you will succeed where others playing games fail. *It is up to you.*

Three-by-Three

The three-by-three concept is developing more slowly than two-by-two. Three-by-three says marketing is just as important as design and manufacturing. It says that you can design and build the best thing in the world, but unless we tell our customers about it, they won't buy it, and the product will fail. The best products of the future will be managed by a partnership of three.

If you think of yourself as a vendor of products, the product manager is your customer. But realize that a product is more than hardware. It is documentation, marketing, software, manufacturing, and support. It is reliability and, above all, it is profitability.

We all work together toward a common goal, but we should be aware of the needs and perspectives that each of us brings to the job. By the nature of things, the product manager is likely to be more keenly aware of the needs of the market than of the problems of development. It is your responsibility to make sure he or she does not try to overcommit you. On the other hand, you owe the product manager the best product money can buy.

In short, you owe the product manager and the manufacturing manager cooperation in your common goal, and awareness and respect for the needs of the market as reflected by the product manager, and for the needs of manufacturing as reflected by the manufacturing manager. You also owe respect to the engineer – yourself.

It is not always possible to identify a product manager. If you cannot identify one for *your* product, *you* are it.

Matrices

Figure 1-1a and b illustrate the latest organization chart for the corporation. The Appendix gives a detailed chart for Office of Development. It can be used best as a guide around the company to let you get in contact with appropriate people quickly.

Notice that the figure implies the traditional pyramid structure. As such, it shows only half of the story. We really operate with a so-called matrix structure. Engineering projects cut horizontally across the organization lines using people from many groups throughout the company. Figure 1-2 illustrates what this means. In a sense, the vertical structure is responsible for people and policies; the horizontal structure worries about products.

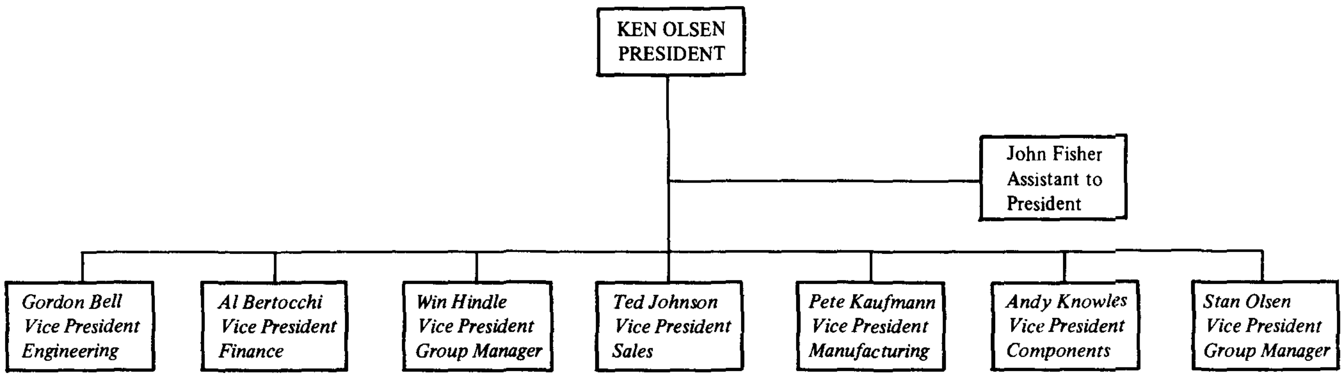


Figure 1-1a
Corporate Organization

STAN OLSEN
VICE PRESIDENT
GROUP MANAGER

Irwin Jacobs
Product Line Manager,
Business Products Manager

Bob Lane
Traditional Products
8 & 11 Typesetting
Manager

Julius Marcus
Vice President
Data Communi-
cations Group

TED JOHNSON
VICE PRESIDENT
SALES

Bruno Duerr
Corporate
Software Services Manager

Gerry Moore
Vice President
N. A. Sales

J-C Peterschmitt
Vice President
Europe

Ron Smart
General International
Region Manager

Jack Shields
Vice President

Gene Smith
Corporate
Public Relations/
Advertising Manager

Craig Zamzow
Sales Training Manager

WIN HINDLE
VICE PRESIDENT
GROUP MANAGER

Dennis Burke
Personnel/OD
Manager

John Holman
CSS
Manager

Ed Kramer
LDP/BIO
Group Manager

John Leng
Vice President
DECsystem-10,
PDP-15

Bill Long
Vice President
OEM Group

Charlie Spector
EPG/ECP
Group Manager

Brad Vachon
IPG
Manager

Figure 1-1b
Corporate Organization

	Engineering	Documentation	Model Shop	Manufacturing	Product Lines
New CPU Project **Product Manager A**					
New Tape Drive **Product Manager B**					
New Disk **Product Manager C**					

Figure 1-2
The Matrix Organization

CHAPTER 2
HOW

This chapter presents an overview of the life of a project. Figure 2-1 illustrates the phases most projects pass through.

2.1 DECIDE WHAT TO BUILD

Objective:

To identify a problem or set of problems our customers have and propose a solution that will help them and bring profit to the corporation, as well.

People Involved:

Engineering (hardware and software)
Customers
Marketing
Product Manager

Tools:

Engineering Proposal (essentially, a functional specification)
Marketing (or Business) Plan

When most engineers start on a project, this step has already happened. Many groups have a five year plan for development. Major decisions on new products are usually made during formulation of these plans.

It is often hard to tell when this phase ends, but two things usually mark the end: project approval, in the form of official funding, and a design review of the functional specification.

Most engineers start their involvement when the functional specification has already been written. Keep in mind that the specification may be (1) incomplete, (2) inconsistent, or (3) impossible for reasons you may discover during the design. In such cases, the specification should be updated with the concurrence of at least the Engineering and Marketing Managers.

2.2 DESIGN IT

Objective:

To translate the functional requirements into a design that manufacturing can use to build.

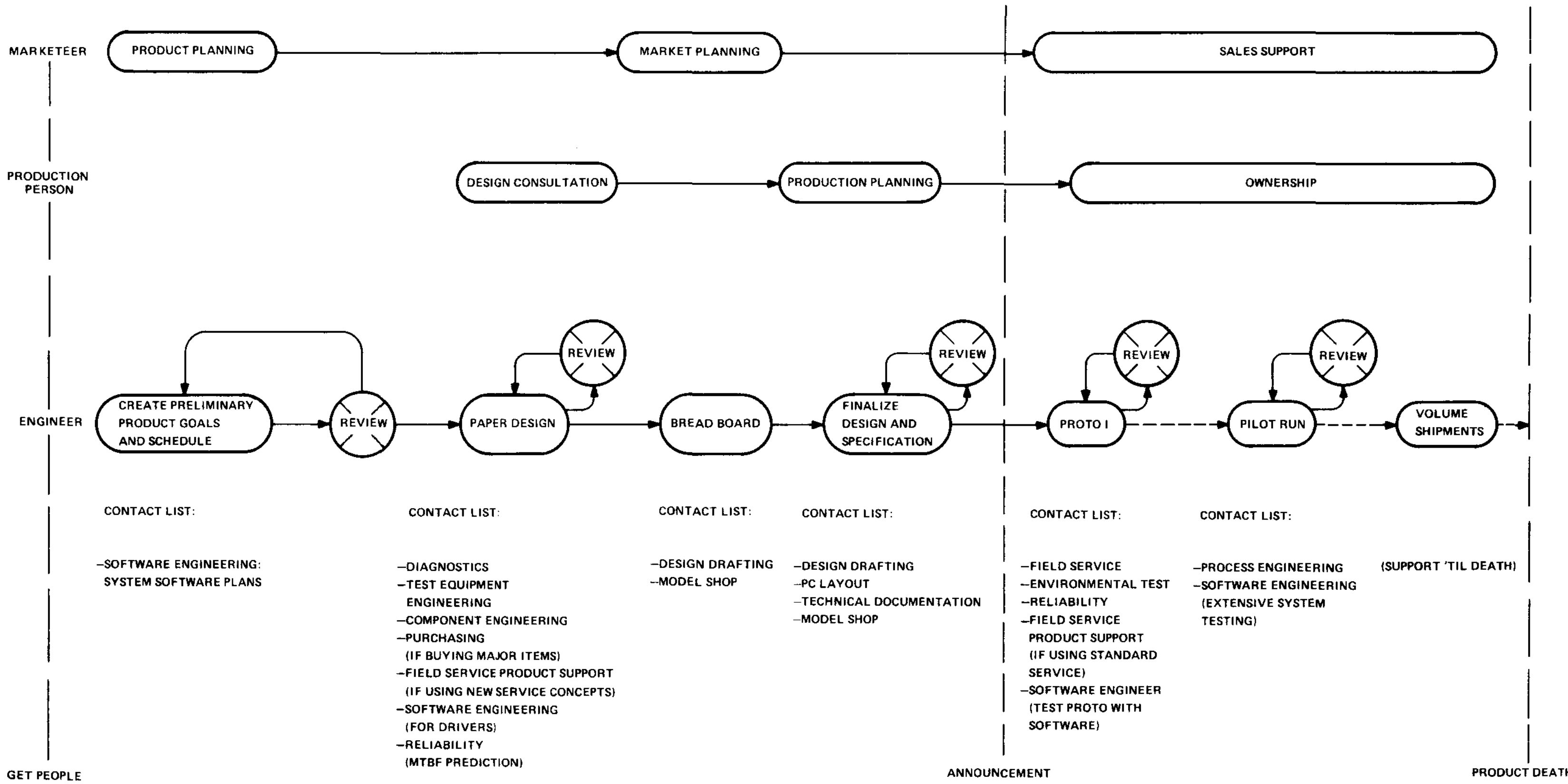
People Involved:

Design Engineer } Principals
Manufacturing Project Manager }
Software Engineering
Component Engineering
Purchase Specification Control
Purchasing
Design Drafting
Diagnostic Engineering
Model Shop
Technical Documentation
Mechanical Engineering/Industrial Design
Field Service Product Support
Stockroom
Reliability Engineering
Central Test Engineering
Process Engineering

Tools:

Functional Specification
Engineering Project Plan
Manufacturing Plan
DEC standards 002, 004, 007, 008, 009, 030, 055, 092, 102

The Design Engineer and the Manufacturing Project Manager are the focus for design decisions. The rest of the people and groups just listed have developed special expertise in their own areas. The assistance they can offer is outlined here briefly. Chapter 3 details the interaction between the engineer and the various supporting groups.



THE LIFE OF A PROJECT

Software Engineering: You should identify a designated consultant who can help you define the software interface. The Software Planning Group can identify such a person. The Software Product Manager's Group should interface with the Hardware Product Manager.

Component Engineering: A component engineer will help you research and specify your component needs.

Purchase Specification Control will provide purchased parts information, vendor information, and DEC standards information.

Purchasing will help with vendor selection, sourcing, and problem solving.

Design Drafting provides manual and automatic design drafting assistance; does manual and automated P.C.* design, provides information about DEC standards, documentation, and corporate guidelines; watches spending; and acts as a communications link for all engineering services.

Diagnostic Engineering can assist in hardware/software tradeoffs and logic partitioning decisions; they also make diagnostics for your product.

Model Shop supplies fabrication in metal, plastic, wood, clay, and foam; assembles prototype modules, small sub-assemblies, and cable harnesses; and provides P.C. board models, hand-testers, odd jobs, and quality testing.

Engineering Stockroom stocks company-preferred components.

Technical Documentation provides documentation planning, technical writing services, publication services, printing, and distribution services.

Mechanical Engineering/Industrial Design can help with industrial design (appearance and product design concepts – panels, colors, etc.) and mechanical engineering (packaging design, materials evaluation, connector tests, heat transfer/flow casting and molded parts design).

Field Service Product Support is a part of field service. They can help you design in supportability features and plan for field support.

Reliability Engineering: Provides early mean time between failure prediction.

Central Test Engineering works with the engineer and the diagnostics people to ensure testability of the product.

Process Engineering will consult with the engineer on our way of manufacturing and the manufacturability of the product. When necessary, they can design jigs and tools to facilitate manufacture.

You should not end this phase without a logic, circuit and/or mechanical design review. Design reviews bring in senior people from outside the project. They help you find problems and can give you advice.

2.3 REVIEWS

A series of design reviews aids the engineer in conceiving and developing the project in a logical and practical manner.

Specification and Equipment Concept Review assures that the specification completely describes the equipment to be designed, including interfaces (physical and electrical) and a functional relationship between inputs and outputs; demonstrates the planned implementation of the design (block diagrams, flow diagrams, analysis, specifications for sub units, etc.); includes mechanical, packaging, test and maintenance, thermal and power requirements, and concepts.

Preliminary Mechanical Design Review should be held prior to generating a complete set of drawings so that the inputs from manufacturing, field service, etc. can be considered. The engineer should show sufficient detail in the project specification or a separate mechanical specification to assure that the design will meet all requirements. He or she may include sketches, models, mock-ups and/or assembly type drawings, analysis, and calculations to show thermal and structural integrity.

Preliminary Logic Design Review should be held as soon as possible after completion of the design and prior to the generation of board layout. The data should include the logic diagrams, some form of specification, preliminary map of the locations of chips and pins, timing diagrams of critical paths, etc.

Preliminary Circuit Design Review should be held as soon as the circuit is designed and the supporting analysis and critical portions have been breadboarded, and prior to the generation of artwork and detailed packaging. The data available should include the schematic, parts lists, stress calculation, stability analysis, power requirements, MTBF estimates and supporting test data.

Prototype Test Review is held to examine the results of prototype testing and conclusions drawn from the test data. It should include the planned corrective action in as much detail as possible. The data supplied to the reviewers should include summaries of the test data and conclusions drawn.

*Printed Circuit

Final Specification Design Review is held to assure that the specification is correct, complete, and acceptable prior to release to Documentation Control. The data supplied to the reviewers is a complete specification.

Pre-Release Mechanical, Logic, and/or Circuit Design Reviews are held to examine the details of changes found desirable or necessary in the prototype manufacture and evaluation prior to limited release for pilot production. The reviews may be combined if the changes are minor.

Final Mechanical, Logic and/or Circuit Design Reviews are held to examine the problems and corrective actions found desirable during pilot production prior to release to full production.

2.4 PROTOTYPE EVALUATION

Objective:

To shake the bugs out of your design; to document what it can *and can't* do.

People Involved:

- Engineering
- Component Engineering
- Model Shop
- Diagnostics
- Environmental Testing
- Reliability

Tools:

- DEC Standard 102

Your test strategy depends on the intended market, the intended manufacturing process, and the object itself. Component engineering, test equipment engineering, and reliability can help with a test strategy. Reliability can also help in statistical analysis.

You will need diagnostics to help test your product. Make sure diagnostic engineering's schedules mesh with your own.

Here is a partial list of the kinds of test equipment we use:

ICs
- Teradyne J384s
- Macrodata 100s

System Testers
- ACT11A
- ACT11B

Module Testers
- CMT
- XOR
- DD11
- General Radio

We have test chambers for environmental testing for heat, humidity, and supply voltage and frequency. These factors can be isolated or coupled. Outside testing facilities are used for additional testing as required.

When you are satisfied with your design and have signed off the print set, Reliability will make some very long tests under controlled, realistic environments. They do this with engineering prototypes and early production models. Total testing in the prototype and early production stages runs between 10,000 and 40,000 unit hours for major, high-volume products.

In order to build a prototype, you will probably need to use the model shop. They have facilities for everything from rough boxes made from early sketches to limited release and production release.

Environmental Testing and Acton Labs do the testing required by DEC Standard 102. Refer to the standard for more information.

2.5 DOCUMENT IT

Objective:

To describe clearly, accurately, and completely the item you are trying to build.

People Involved:

Creators:

Design Engineers and Technicians Satellite Supervisor Design Drafting P.C. layout (manual and automated)	Internal Documentation
Design Engineers and Technicians Training Technical Documentation	User Documentation

Users:

- Manufacturing
- Field Service
- Training
- Customers
- Software Engineering

Maintainers:

- ECO Control (Internal Documentation)
- Technical Documentation (User Documentation)

Tools:

- Functional Specification
- Field Service Philosophy
- DEC Standards 003, 010, 012, 013, 014, 015, 018, 019, 020, 021, 022, 023, 024, 050, 054, 056, 100

Internal documentation is required to allow manufacturing to make your project and field service to service it. User documentation allows our customers to get the best use from your product.

You ought to contact the Technical Documentation Group and your satellite supervisor when you are setting up your schedule. They can help you with that, and with your budget.

In general, the more information you put into your specifications, drawings, and so on, the faster and better the documentation job. In the technical documentation area especially, the biggest problem is access to good information. Try to make yourself available for questions.

Good documentation allows our field service people to save money. Even more important, it makes our people more efficient. This is important when the supply of qualified people is limited. You can work a significant cost savings for your product by making sure you get the best documentation possible.

P.C. layout can be manual or automated. The manual job takes eight to ten weeks; the automated job takes less. For boards made to DEC Standard 030, with fewer than 100 ICs, automated P.C. layout takes four to five weeks, and there is no need for an extra week for GEMS* digitizing.

Once you authorize limited release of your product, your drawings go under ECO control, and you must sign off any changes made after that. DEC Standard 100 describes the ECO process. Make sure the Training Department is aware of your product and is scheduled to give courses at the appropriate time. They can give you feedback on how much documentation is necessary. Anything *you* don't supply that they need, *they* will have to write themselves – at greater expense (because they often have less information to work with) and with less general usefulness (because training materials do not get the same kind of distribution that standard user manuals get).

When you are ready to sign off your prints, you should hold a design review.

*GEMS is described in the paragraph on Design Drafting, Chapter 3.

2.6 TEST IT

Objective:

To make sure we have testing equipment and procedures for manufacturing and field fault detection and analysis.

People Involved:

- Engineering
- Manufacturing Manager
- Test Strategist (A representative of Test Equipment Engineering)
- Reliability
- Environmental Test
- Diagnostic Engineering
- Model Shop

Tools:

- Test Strategy
- Business Plan (For projected volume)
- Manufacturing Plan

The engineer, a person from the manufacturing team, the test strategist, and people from reliability, diagnostic engineering and Field Service Product Support should work out the manufacturing and field test strategy.

Test equipment engineering will take care of volume production of testers; the model shop will make testers in small quantities.

2.7 GETTING IT INTO MANUFACTURING

Objective:

To translate your design into objects our customers can use.

People Involved:

- Engineer
- Manufacturing Manager and Team
- Drafting
- Field Service
- Marketing
- Relevant Plant's Materials Manager
- Purchasing
- Component Engineering
- Purchase Specifications
- Process Engineering
- Central Test Engineering
- Diagnostics

Tools:

- Business Plan
- Manufacturing Plan
- Parts List, Purchase Numbers, and Purchase Specifications
- Product Line Forecast

Procedure

More important than anything else, you must identify the manufacturing facility that will build your product. The choice of manufacturing facility will influence the choice of your 2X2 partner. You should identify that person very early in the life of your project. Here are the kinds of things required for introducing a product to manufacturing:

Complete Documentation:

Complete parts list, including part numbers and purchase specs.

Manufacturing print set for all modules and testers.

Training for technicians

On-site support

Diagnostics and tester software. (Major systems use so-called ACT testers – Automated Computer Testing. Software for such systems must be budgeted separately.)

Models

Templates for insertion, or tapes

Multi-sourcing for new components

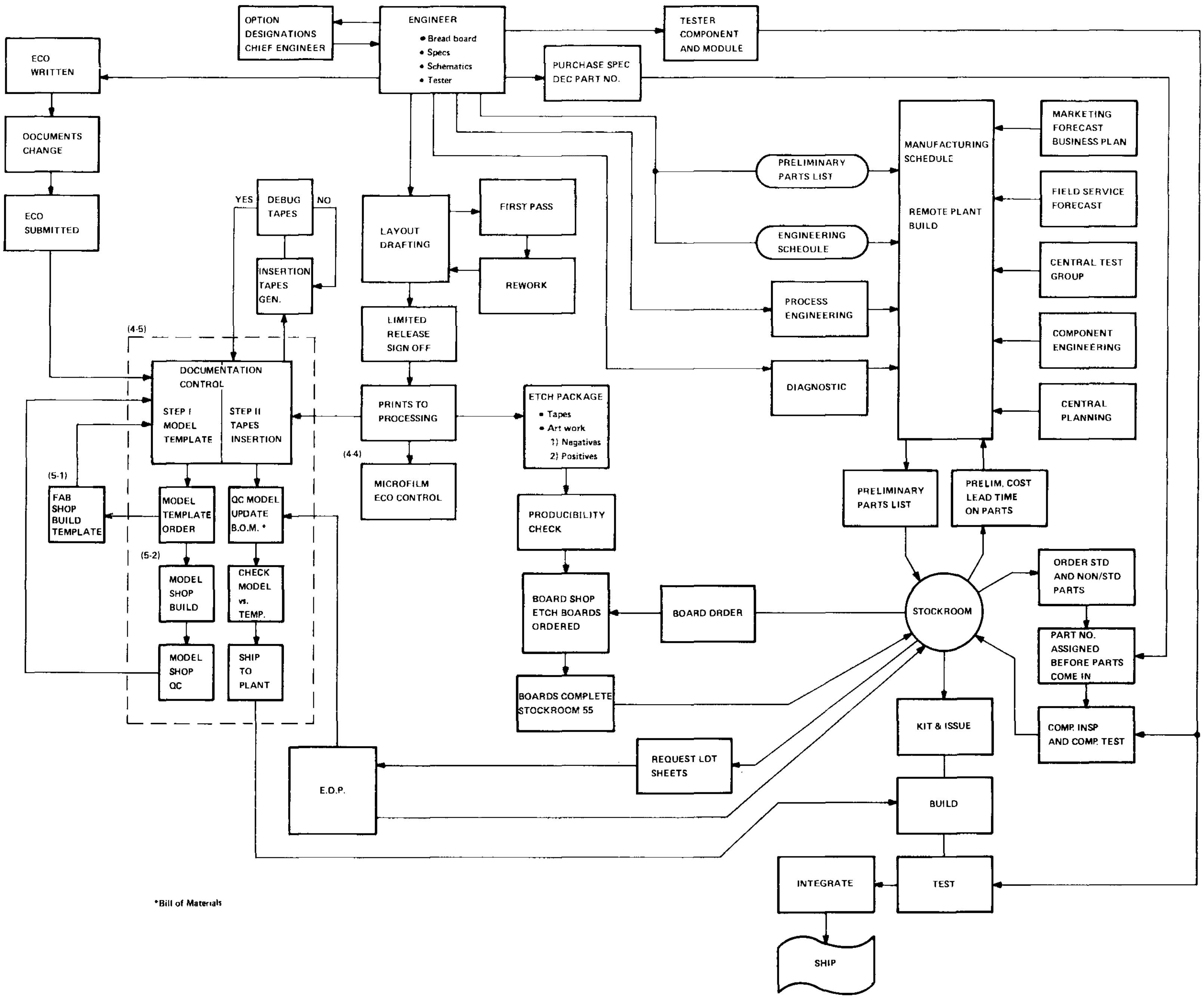
Incoming inspection procedures and test equipment

Testing procedures and equipment

If you are using new or unusual parts, be sure to allow enough time for the facility to stock them. Purchasing can help you with this kind of information. Figure 2-2 is a flow chart showing the steps for getting a product into manufacturing.

2.8 INSTALL AND ACCEPT IT

The engineer, field service product support person, and marketing manager, with the help of the systems programmers, diagnostic programmers and software support people, should work out any necessary installation procedures and a customer acceptance test upon completion of the system the customer pays for.



*Bill of Materials

Figure 2-2 Getting a Product into Manufacturing

CHAPTER 3
WHO

An engineer may not need the services of all the groups described in this chapter, but he or she should know what help they can offer and at what stage of product development an engineer should seek their help. The purpose of the planning stage is to forecast which groups will deal with the project and when. The project budget ensures that the engineer can get help when needed.

3.1 SOFTWARE ENGINEERING (Prime contact: Mel Woolsey)

The support that systems software gives to a product is a function of budget and negotiations between the hardware and software product managers. When software engineering supports a device, they do (potentially) all of the following:

1. Help define "functionality."
2. Help specify the implementation (bit layout).
3. Write I/O drivers for many operating systems.
4. Worry about the special conditions peculiar to so-called system devices (characteristics of system devices include random access and high speed).
5. Modify system generation procedures to include the new device.
6. Augment error-logging code, if needed.
7. Enhance stand-alone utility programs such as ROLLIN, if needed.
8. Write code for hardware bootstrap, if needed.
9. Worry about devices that may serve as distribution media (e.g., paper tape, DECtape, cassette, RK05, etc.), as follows:
   a. Distribution may affect packaging of the product.
   b. New order codes must be assigned for all affected software.
   c. The Software Distribution Center (software's equivalent for manufacturing) must obtain equipment to duplicate the software on the media.
   d. The Software Distribution Center's copy and verification software must be written.
10. Create on-line diagnostics, if needed.
11. Document all the above actions.
12. Create spooling programs, if needed.
13. Integrate this work into many, asynchronous schedules.

Currently, contacts with software engineering often happen on an *ad hoc* basis, and usually require persistence on the part of the engineer. If your product is affected by software, it is important to make this relationship.

In the early stages of product planning, this is what should happen:

1. The hardware product manager should see the software product managers' group leader in the early stages of the business plan.

2. That person should log the contact and redirect the request to the appropriate software product manager.

3. The product manager should establish the software end of the business strategy: "Will we support this device?" "In what systems?" "To what degree?", etc., and coordinate with the appropriate development manager(s) to obtain a commitment and resolve budgets, schedules, resources, etc.

4. This commitment, in the form of a formal revision to the software project plan, is conveyed by the software product manager to the responsible hardware manager for inclusion in the hardware manager's plan.

Software engineering primarily functions to create software for customer use. In carrying out that function, they use production equipment and expect a high level of reliability and service, as any customer would. Software engineering also supports new devices. In this role, the equipment they use is radically different. They need to test their systems on unproven prototypes and pilot run units. For such testing, the following issues must be resolved:

a. Who capitalizes the system?
b. Who services the system?
c. Who operates the system?

Not only should your prototype test configuration be able to contain the system software (i.e., with enough core and peripherals), but it also should be as well human-engineered as possible. For example, printers for listings and Teletypes should have an adequate supply of paper and ribbons. The system should be as clean as you can make it. Try to avoid hanging wires, etc.; try to be sure the console terminal is close to the console, not ten feet away.

In general, it is not sufficient to test hardware with diagnostics and functions exercisers. System software should be used to test new devices at the prototype stage. Before announcement, early models should be thoroughly tested with system software.

The software product managers' group can help you decide which operating systems should support your product and put you in contact with the proper people.

Software Engineering Standards

The Software Engineering Standards Committee is responsible for defining standards relating to data formats, file structures, and anything else pertaining to hardware/software interfaces. If you think your product requires a new standard, or if it must conform to existing standards, contact engineering's representative on the committee.

Designated Consultants

There are people in software engineering who know a great deal about how software must interface with certain device classes, such as disks and terminals. If you cannot identify one for your area, the Software Planning Group will help you find such a "designated consultant."

When Should you Contact Software Engineering?

1. Contact the software product managers' group as soon as you have funding (or before).

2. Before you fix the design, contact your designated consultant.

3. When detailed specs are available, drivers for testing the prototype should be started.

4. When the prototype runs a function exerciser without errors, you should test it with system software.

5. When pilot run occurs, system tests should be planned and implemented.

What Software Engineering Can Supply an Engineer

1. A decision on which systems should support the device.

2. Commitments to support it on those systems on a date consistent with product line needs and software engineering's ability to schedule the Software Distribution Center.

3. Help in defining the software interface which will come from the designated consultant and must occur during the early functional design stage.

4. Drivers for testing the prototype with system software.

5. Extensive testing on pilot run units.

What Software Engineering Needs From the Engineer

1. Early contact.
2. Persistence.
3. Detailed specs from which to create drivers and define intelligent tests and standards.
4. Test configurations and any agreed-upon service, operation, and capitalization.

Management Tools that Help Make This Relationship

1. Business Plans to help decide which systems should support your product.
2. Specifications to allow drivers and standards to be created.
3. Project Plans. Software Engineering uses a fairly well-defined project plan outline. Each project leader must create a project plan for each project. This is probably a good vehicle for making sure you get the support you need. Either your device should be mentioned in a more general project's plan, or they should define a special project for supporting it.
4. Software Engineering Standards.
5. Test Plans. Formally or informally you should agree on a test plan that will wring out your product before customers can get their hands on it.
6. Engineering Functional Specifications to allow drivers to be created.

3.2 COMPONENT ENGINEERING (Prime contact: Dick Amann)

When Should you Contact Component Engineering?
As soon as you contemplate a new component. Description of the Purchasing/Component Engineering process is contained in Paragraph 3.4.

What Component Engineering Can Supply an Engineer

Documentation – Ensure technical content and accuracy of:

Purchase Specs

Qualified Vendor Lists (QVLs)

Component Index

Incoming Inspection Procedures

Master Parts File Descriptions

Generate:

Missing Incoming Inspection Documents

Incoming Inspection-Related Documents (Test Programs/Tester Documentation)

Component/Testing/Evaluation Audit Guidelines

Master Parts File Component Ratings

Purchase Spec Formats

DEC Alert Notes (Specifying Component Problems)

Component Testing – Component engineering also generates audit guidelines to ensure that component testing and component purchasing at all manufacturing locations are performed in accordance with standard Digital procedures.

- Select and specify test systems.
- Order and expedite tester hardware or software purchased outside.
- Generate component tester test programs per Digital specification and incoming inspection procedures.
- Perform a QC function on tester hardware and software purchased outside to ensure that it meets Digital's testing requirements.
- Distribute test hardware and software to the requesting plants.
- Maintain a status of test capability for all plants.
- Determine screens to be applied to purchased components.
- Specify and select equipment needed to perform screens.

Solution of Manufacturing Problems – Device and test problems.

Evaluations – The component engineering group provides resources to fight "crisis" component problems at all manufacturing locations, regardless of whether the problem is equipment or component related. This includes a commitment to hold periodic "Component Evaluation Consortiums" during which priorities of additional source evaluations will be set. Included in this item are failure analysis, correlation of vendor reject data, and initiation of corrective actions. Evaluations are made of:

- New parts
- New technology
- New suppliers, including companies with which Digital may enter into technology cross licensing.
- Additional sources.

Another function of the group is to perform evaluations on purchased parts including the development of a well equipped evaluation lab and the development of evaluation procedures.

The Lab – Component engineering will develop a lab to accomplish this charter:

- Support for manufacturing and engineering projects.
- Failure analysis.
- Evaluations of components and processes at package and chip level.

The 2 x 2 System of Bringing New Components or Technologies into Digital – Component engineering works with design engineering to introduce new parts and technologies into the corporation in a manner that will ensure successful application. As part of the project development costs, they are responsible for the following:

- Qualify each vendor's QC procedures and test plan.
- Evaluate the vendor's process and design.
- Generate a test plan for Digital and supervise its implementation.
- Qualify the vendor based on performance for some predetermined number of parts/lots shipped to Digital.
- Perform a failure analysis on failed parts during the qualification phase and feed the results back into the test plan.
- Continue to support the part or technology throughout its manufacturing life.
- Continue to monitor the test plan so that intelligent changes can be made that will reduce the testing cost.

Vendor Quality Measurement System – Component engineering initiates the periodic monitoring of shipments from our vendors and develops meaningful vendor rating schemes.

Generate Test Flow and Capability to Systems Integration Area for Highly Complex Devices Used in High-Volume Manufacturing – For certain highly complex, system-on-a-chip type devices used in high volume manufacturing, the component engineers' responsibility extends to providing test flow capability through to systems integration.

What Component Engineering Needs From the Engineer

1. Early consultation
2. Funding for projects to be undertaken

Management Tools that Help Make this Relationship

1. Part Number Request Forms for all new components must be signed by component engineering before parts are approved for use by Digital.
2. The *Component Index Book* and the *90 Class Index Book* are circulated.
3. Parts reviews of new products are made.
4. DEC Standards.

3.3 PURCHASE SPECIFICATION CONTROL (Prime contact: Bill Burns)

When Should You Contact Purchase Specification Control?
When engineering design is firm.

What Purchase Specification Control Can Supply an Engineer

Purchased Parts Information:

1. Assist engineer with purchase specification requirements.

2. Purchase specification writing and typing.

3. Purchase specifications – master file maintained.

4. *Multi-class Component Index Book* – available by request.

5. *90 Class Component Index Book* – available by request.

6. Incoming inspection procedures – file and distribute only.

Vendor Information:

1. VSMF – microfilm cartridges by vendor name and purchased commodity. Military specifications and standards are also available.

2. Selected vendor catalog files based on activity level.

3. Qualified vendor listings primarily for purchasing and incoming inspection use.

DEC Standards:

1. Administration and distribution.
2. Subject to engineering committee approval.

What Purchase Specification Control Needs From the Engineer

1. Good purchase specification inputs (known fixed requirements).

2. Positive response when requested to sign off a finished specification (i.e., same day).

3. Proper planning of design schedule to allow specification control sufficient time to process requests.

Management Tools that Help Make this Relationship

1. All purchased parts released to volume manufacturing must reflect a Digital-assigned part number (i.e., 10–99 classes) for control and identity.

2. Prior to part number assignment, a Part Number Request Form must be filled out and fully approved. A hand-written spec and/or vendor data sheet must accompany the part number request for approval signature and submission to spec control. Forms may be obtained by dialing our information desk at Maynard, Building 5-4, Ext. 2050.

3.4 PURCHASING (Prime contact: Andy Dufresne)

When Should You Contact Purchasing?

During the planning stage.

What Purchasing Can Supply an Engineer

Purchasing can provide the long term business picture in the component selection process: Is the usage of that component type a long term viable approach? Will Digital's existing and proposed usage outstrip the capability/willingness of the marketplace to provide? Is the cost structure of that component realistic relative to the actual quantity usage during prototype stages, pilot production, and high-volume production? Are we designing in specialty items that will limit Digital's multiple sourcing capability and its ability to grow? What has been the historical relationship between that vendor and Digital?

Specific purchasing engineer/analysts are assigned to general part classes to assist you and the buyers in vendor selection sourcing and problem solving.

Consortiums are formed to handle high-volume, repetitive, on-going requirements. The purpose of a consortium is to put Digital in the best possible position to achieve ultimate pricing and delivery performance from the marketplace. Consortiums are composed of part class buyers from each buying location, the component engineer, and the purchasing engineer/analyst with that commodity responsibility, headed up by a commodity manager with leadership responsibility for that commodity group.

What Purchasing Needs from an Engineer

1. Specification details
2. Quality standards

Management Tools That Help Make This Relationship Communication.

Purchasing Group Locations and Services in Maynard

Field Service Purchasing (PK 3-2) – This group services all the part service requirements for customer support in the field.

Maynard Manufacturing (Mill complex, 5-4) – This group services all the inventory and expendable material requirements of that organization.

Supplies and Services Purchasing (Mill complex, 5-4) – This group is responsible for supporting all other groups in the Maynard complex not mentioned specifically. Out of this group comes the support for the engineering world. Some of the major classifications of this group are capital equipment, chemicals, lab supplies, line printer paper, tools, consultant services, nonstandard office equipment and supplies, and the complete line of inventory class items in support of the engineering groups located in the Maynard complex.

Corporate Purchasing (currently located at Mill complex, 5-4) – This department functions as coordinator and policy maker, representing purchasing to the corporation and marketplace. Corporate purchasing provides the purchasing interface to Digital management (finance, legal, engineering, marketing, and others) and provides training, technical support, EDP tools, and analytical data to enable field purchasing groups to operate more effectively.

Purchase Orders (from *Office of Development Handbook*)

1. What is a purchase order?
   A purchase order is a document that indicates the company's commitment to take delivery of a product or service from a vendor outside the company. It also serves as an accounting document because it indicates the cost center, account, and, if applicable, the project to which the resulting expense is to be charged.

2. How to fill out a purchase order.
   Leave most shaded areas blank. A purchase order must be signed with an approval signature by a person authorized to sign purchase orders for at least the amount of the purchase order. Enter your badge number, cost center number, and the account number to be charged.

3. Accounts commonly used on purchase orders.

Expense charged directly to a project	**Expense charged to cost center overhead**	
8381	7326	
8384	7351	
	7353	
8389	7329	
	*2109	Typewriters
	*2105	Engineering test equipment

NOTE

An account from the left hand column (known as "80 range accounts") must be used to charge a project. If you enter an account number other than 80 range, the expense goes to your cost center overhead no matter what project number you put down.

4. ACT CODE
   This means activity code. In order to charge a project you must enter a letter that is an applicable activity code for your cost center. In general, these codes are:

Diagnostic Engineering	V
Software Engineering	P
Hardware Engineering	E

   ACT. CODE must be filled in if you used an 80 range account. If you did not use an 80 range account, leave ACT. CODE blank. Three boxes, labeled 1, 2, and 3, appear next. These boxes are used to indicate the project to be charged. Therefore, if you used an 80 range account, enter project number as follows:

1	2	3	
98	03112		The project number must be a valid one. Accounting publishes a list of valid numbers monthly.

   Box 3 is always blank for engineering cost centers. If you did not use an 80 range account, leave 1 through 3 blank.

*Capital Account used only for capital equipment, i.e., equipment with enduring value not to be used for purchase of services or software.

5. Additional Information
   Buyer code – Leave blank.

   Requested by – Enter your name.

   TEL EXT – Enter your phone extension.

   Location – Enter your office location, e.g., Maynard 1-3.

   Sales Tax – always check "taxable" unless it is to be used in units that will be shipped.

   Ship to – Since we use the same purchase order form in several locations, you must check off where you want the product delivered. For bulky or heavy objects, indicate a receiving dock close to where the equipment will be used. Receiving docks are located at:

   Maynard Mill Dock, 5-1 Thompson Street, 5-3 Thompson Street.

   Parker Street, PK 1, PK 3-1.

   In the body of the purchase order, indicate quantity, description, and part number (if known). Once the purchase order has been approved, send to the Purchasing Department at Maynard, Building 5-4.

3.5 DESIGN DRAFTING (Prime contact: Dick Reilly)
Design Drafting is decentralized so that the drafting and printed circuit design services can be closer to engineering. Engineering services and drafting satellites are located in the Mill, Buildings 1, 4, and 5, and in Marlboro.

These satellites perform five basic functions:

1. Provide manual and automated design drafting assistance.
2. Do manual and automated P.C. design.
3. Provide information about DEC Standards, documentation and its structure, and related corporate guidelines.
4. Watch spending for all engineering services.
5. Act as communications link for all engineering services.

Your principal interface with design drafting is the satellite group supervisor. If you are uncertain which satellite area services your group, call the prime contact.

When Should You Contact Design Drafting?
When you have official funding, contact your satellite supervisor. He or she will prepare a complete estimate of time, money, and necessary data or forms required for your project. Design drafting annually forecasts in June. Satisfactory results in providing support are heavily dependent upon forecasting, planning, and early interfacing with the satellite.

Engineering services satellites should be informed about project requirements as early as possible. Preliminary conversations should develop an awareness about a project's potential size and possible type of support so that proper planning and staffing can be arranged; the project definition can be developed through additional meetings.

What Design Drafting Can Supply an Engineer

Engineering Drafting – Design drafting's objective is to create the documentation needed to describe an engineering design and release it to production. Design drafting has a responsibility to follow generally accepted good drafting practices and, in particular, to follow DEC Standards and corporate guidelines.

If you are heavily involved in documentation, you should ask your satellite supervisor for a copy of the *Production and Engineering Services Drafting Manual*. This manual is distributed to a limited list of individuals involved in documentation and is under ECO control.

Existing documentation standards relate to numbering codes, drawing directories, documentation quality for microfilming, casting, harnesses, cables, lettering, dimensioning practices, schematics, and checking drawings. There are *no* standards in flow and timing diagrams. Design drafting personnel in the satellites know the general trends for the product lines they support and try to keep each product line internally consistent while always satisfying basic requirements of existing corporate standards.

P. C. Layout – Design drafting performs manual and automated printed circuit layout. The increasing use of automated techniques has improved both the turn-around time and quality control. CALDEC, the major automated system in use, allows board layout by a P.C. designer utilizing the GT15 graphic display unit controlled by a PDP-15. In 1974, almost one-third of the boards were done using CALDEC; in 1975, the proportion should double.

Manual P. C. layout uses the GEM system to digitize the manual drawing for line, hole, and component placement data. Boards designed using CALDEC and those digitized via GEMS both go through automated post processing for space and continuity checking, preparation of check plots, creation of numerical control tapes for drilling and component insertion, and creation of glass artwork.

To take advantage of the current automation capability, the engineer should design with CALDEC in mind; that is, component density should be kept down and the schematic and parts list kept clean and up-to-date. The present automated system is memory-limited in its ability to handle high-density boards. The effect of high density on design time is shown in Figure 3-1.

Any type of board can be made by manual design. The development time is dependent upon size, density and circuitry. In order of increasing difficulty, these types are:

1. DEC Standard 030 boards
2. Nonstandard boards
3. High-density boards
4. Multi-layer boards
5. Multi-layer, high-density boards

What Design Drafting Needs From an Engineer

1. Proper funding and project schedules.
2. Sketches.
3. Conversation and close interaction.
4. Engineering drawings.

3.6 DIAGNOSTIC ENGINEERING (Prime contact: George Plowman)

When Should You Contact Diagnostic Engineering?
It is extremely important for diagnostic engineering to participate in the very early conceptual stages of the development of the product. This allows time for incorporating hardware/software tradeoffs that are necessary to ensure a producible and maintainable product.

What Diagnostic Engineering Can Supply an Engineer
Diagnostic engineering is involved in a product from its conception through its entire life cycle and it is a tool that the engineer uses to meet the performance, producibility, and maintainability goals for the product. This is accomplished through an understanding of these goals and of the hardware/software tradeoffs that can be made to afford a practical solution to these goals. During the course of the engineer's involvement in the product, diagnostic engineering provides the following:

1. Product Concept and Project Planning Phase

   - Participate in the generation of engineering, manufacturing, field service, and diagnostic plans for the product.

2. Product Design Phase

   - Participate in product design and assist engineer in hardware/software tradeoffs and logic partitioning decisions.

3. Engineering Checkout Phase

   - Provide design check programs to validate hardware design per specification.
   - Provide special assistance during design checkout.
   - Provide test software to ensure that the product can be integrated into the systems environment.
   - Provide special evaluation programs as may be required by the engineer.

4. Release of Product to Engineering

   - Provide semiconductor and module test programs for manufacturing.
   - Provide device and system test programs for use by manufacturing to meet specified manufacturing goals.

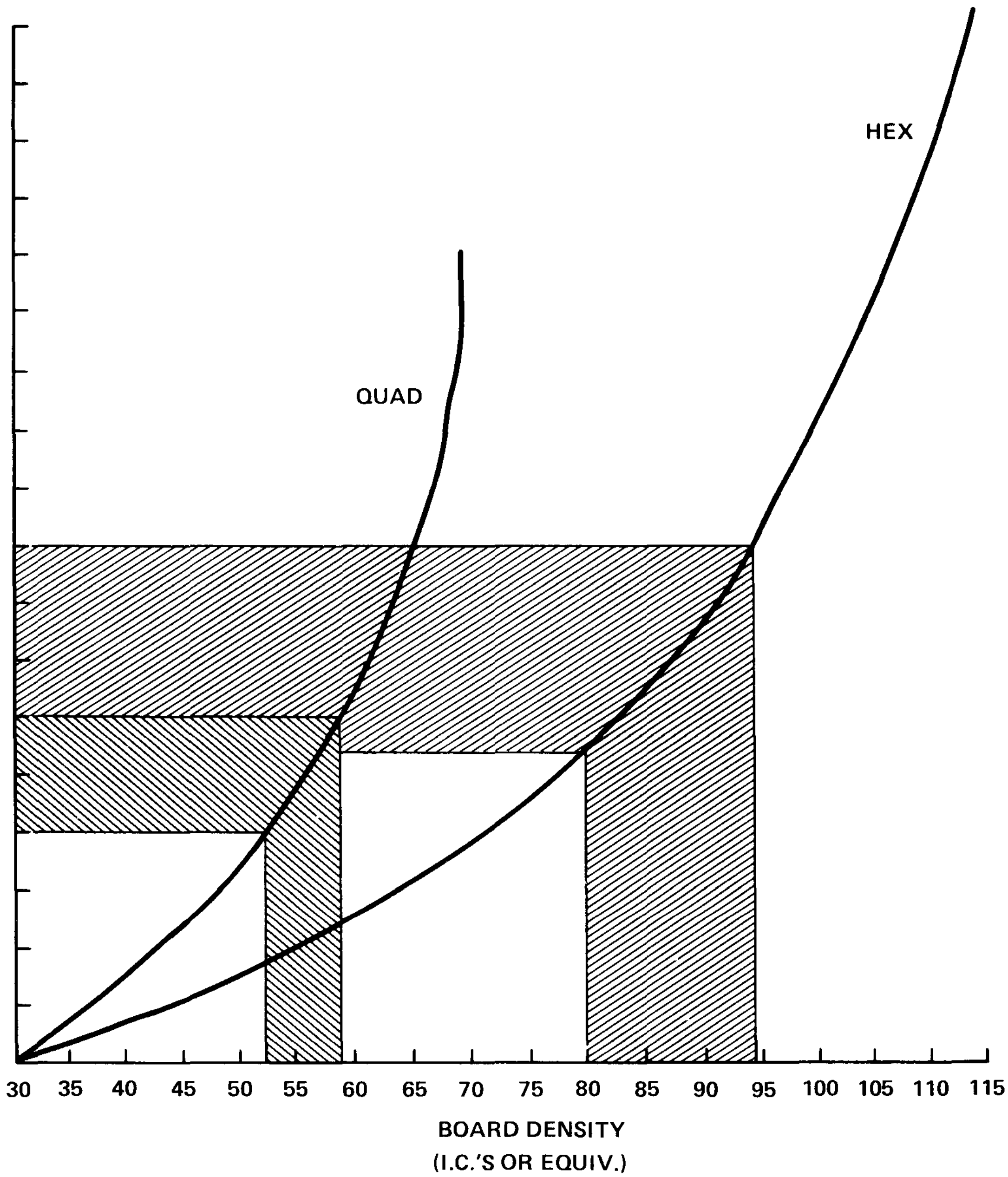
5. Shipment of the Product to Customers

   - Provide maintenance programs to field service in accordance with specified maintenance goals.
   - Provide continued sustaining support for the diagnostic programs during the life of the product.

MAN–HRS VS. BOARD DENSITY

SYSTEM TIME

(Shaded areas indicates preferred limits)



What Diagnostic Engineering Needs From an Engineer

1. A project plan and project leadership to coordinate the efforts of the other project team members.

2. Concept review, design reviews, design specifications, schedules, project reviews, etc.

3. Funding to support product development and maintenance effort for diagnostic programs.

3.7 THE MODEL SHOP (Prime contacts: George Geralds, Manager; Sheila Farland, Material Controller)

When Should You Contact the Model Shop?

1. Machine shop, prototype assembly, and production model shop – whenever you need them. If they can't handle your job, you can talk with the engineer whose job they are working on and try to work something out.

2. For odd jobs and testers, they need a month's notice because these have low priority.

What the Model Shop Can Supply an Engineer
The model shop comprises four groups:

1. The machine shop fabricates sheet metal, plastic, wood, clay, or foam mock-ups, and furnishes machine shop services in general. They can tell you what is easy or hard to manufacture.

2. The prototype shop assembles prototype modules, small sub-assemblies and cable harnesses. They also can tell what is hard to manufacture; they look for errors.

3. The production model shop provides:

   - P. C. board models for limited release (LR) and production release (PR).

   - Sub-assembly models other than PC boards for LR and PR.

   - Hand testers for items that don't use AMT or CMT standard test equipment or low-volume items.

   - Odd jobs – anything at all, from wire wrap boards to show mock-ups to low-volume customer production to harnesses and cables that the prototype shop can't build.

   - Quality Control – this goes for all models (PR and LR) and anything made for a customer.

4. The engineering stockroom – stocks company-preferred components to avoid obsolete or non-preferred parts being designed into new units.

What the Engineer Must Give the Model Shop

Machine Shop – A valid charge number on a filled-out work order and some idea as to what is desired. The more details you supply, the more they are likely to build what you want. Sketches, blueprints, verbal instructions. This process almost always takes several passes. Please don't order more than you absolutely need until you know what you want.

Prototype Shop – A valid charge number on a filled-out work order; an assembly hole (AH) drawing; a parts list and a circuit schematic. The prototype shop works closely with design drafting. If you want a prototype from design drafting, they will forward the documentation to the shop, and the prototype shop will use their work order. The engineer must ensure that design drafting and prototype assembly do not get out of phase when changes occur in the design. The procedures are rather informal, to make changes easy, but that means *the engineer must be careful that everyone knows what is going on.*

Once in design drafting, more or less automatically the prototype shop makes up a prototype. If you need special work done outside of the design drafting loop, go to the materials controller and fill out a work order.

As with the machine shop, this process almost always takes several tries. Please don't order more boards (or whatever) than you need until you know what you want.

P.C. Boards – LR (limited release) and PR (production release):

1. Contact your satellite supervisor or the ECO layout group for LR or PR.

2. After that, work usually flows automatically to the model shop with the required documentation.

3. The engineer must sign the verification tag on *each* model before release.

Formal Print Sign-off:

1. Handled by ECO Layout group.
2. Required after QC for LR and PR.

Sub-assemblies -- LR and PR:

1. Contact model shop supervisor with formal or informal documentation to build from.

2. Must have Release Request Form signed by Dick Best (for power supplies or catalog items), and by drafting for anything else.

3. Engineer *must* sign verification tags on *each* item released.

Formal Print Sign-off:

1. Handled by model shop.
2. Required after QC for LR and PR.

Parts for LR or PR:
You will save time if you supply new and/or unique parts at time of release request.

For hand testers, all that is needed is a schematic, which may be formal or informal. Any critical areas, such as short wires or shielded wires etc., and any special notations must be on the print. Odd jobs for customers require formal documentation. Anything goes for other types.

Engineering Stockroom – The stockroom needs a valid charge number and lead time for parts they don't keep in quantity. When design drafting has made up a parts list for an option, they forward a copy to the engineering stockroom. The stockroom will usually try to buy time by ordering immediately, but for unusual cases, they will ask the engineer whether he or she really intends to use the part.

NOTE
Before parts can be ordered in quantity, before they can go through purchasing more than three times, and certainly before they get to the production model shop, they must have a purchase spec and a DEC number.

Management Tools That Help Make This Relationship

1. Work Order
2. Production Release Request Form
3. Parts List
4. Purchase Specs

Work Orders for Model Shop
The model shop in Building 5-3 (Mill complex), contains facilities for most sheet metal and milling operations. Some limited welding capabilities. Five men work in the mechanical part. (Prime contact: Ed Mayall)

Necessary steps to follow:

1. Come up with a sketch.

2. Take sketch to the woman in the office next to George Geralds (5-3).

3. She is responsible for typing out work order form (she will provide form).

4. Take order form with print to Ed Mayall for delivery date.

5. He will call when work is done.

NOTE
Delivery date is automatic; don't pay much attention to it. It can be negotiable with Ed.

Another model shop is located in Building 5-1 (Mill complex). The main function of this group is to make models for manufacturing. (Prime contact: Kevin Stankard)

Necessary steps to follow:

1. Fill out work order and submit sketch.

2. Check on them periodically.

3. You may have to supply materials at times, but generally they have everything in stock.

This shop is normally used for:

1. Large quantity items (10–20).

2. Complicated parts such as a panel with many holes or grill work.

The model shop in Marlboro is located in Building 1-1. (Prime contact: Arthur Huttla)

3.8 TECHNICAL DOCUMENTATION (Prime contact: Michael Moffa)

When Should You Contact Technical Documentation?

1. Prior to any formal periodic budgeting activity, with regard to current project costs and schedules.

2. To obtain hardware manual cost and schedule estimates for proposed new product design and development.

What Technical Documentation Can Supply an Engineer

1. Documentation planning and coordination.

2. Technical writing service.

3. Publication production service – Editing, illustrating, manuscript typing, typeset composing, and layout.

4. Coordinated printing, distribution, inventory, and revision control of the following types of hardware manuals:

   Site Preparation and Planning
   Installation Procedures
   General Description
   Theory
   Servicing
   Preventive Maintenance
   Illustrated Parts Breakdowns
   Operation/Programming
   System Reference Manuals (hardware-oriented)

What Technical Documentation Needs from an Engineer

1. A documentation plan that has been formulated by the product manager or project engineer, product support field service engineer, training course developer, and technical documentation writing group supervisor.

   The documentation plan should indicate the scope of the hardware manual project, schedule requirements, and the approved budget for the project.

2. Engineering drawings, equipment specifications, and any other technical information available.

3. Usually some engineering time for technical information and manuscript review.

3.9 MECHANICAL ENGINEERING/INDUSTRIAL DESIGN (Prime contact: Dave Nevala)

When Should You Contact Mechanical Engineering/ Industrial Design?
Very early – prior to any hard design solution being fixed.

What Mechanical Engineering Can Supply an Engineer

1. Industrial Design, i.e., product appearance and product design concepts, panels, colors, etc.

2. Mechanical Engineering, i.e., packaging design, material evaluation, connector tests, heat transfer/flow casting, and molded parts design.

What Mechanical Engineering Needs from an Engineer

1. Description of the problem.

2. Market data.

3. Preliminary engineering specs and initial design concepts.

4. Production volume.

5. Estimated sales price or costs.

Management Tools That Help Make This Relationship
Only the understanding by engineers that service is available.

3.10 PRODUCT SUPPORT (Prime contact: Don Busiek)

When Should You Contact Product Support?
At least as soon as official funding starts – sooner for high volume or high cost items. For one-of-a-kind things, 3–4 weeks before shipment.

What Product Support Can Supply an Engineer

1. A responsible person.

2. Failure Data for existing products.

3. Ideas regarding maintainability (e.g., packaging and simplicity).

4. Design recommendations for maintaining machines.

5. Specifications for kinds and level of diagnostics.

6. Specifications of kinds and level of documentation.

7. Field cost per failure.

8. For cross-product peripherals, kinds of system diagnostics required.

9. Design tradeoffs, especially MTBF and MTTR for OEM vs commercial products.

10. System software considerations, especially for large machines.

What Product Support Needs from an Engineer

1. Understanding of field service costs.

2. Warning that product X is coming (big warning for big/high volume products, little warning for little/low volume products).

3. Data.

4. Product Plan.

5. Up-to-date specs.

Management Tools That Help Make This Relationship

1. Product Plan

2. "Maintenance Philosophy"

3. FSSP Statistical sort package (Call Faye Ibrahm)

4. Accounting Tools

5. Field Service Installation Quality Reports

Field Service Product Support Checklist

In general, with very high volume products such as the ones we make today, the more engineering helps the field service people, the lower the total cost to the corporation. You can reduce field service costs by doing your best to incorporate the following items into your design. Above all, try to continue working until you meet the goals set forth in the product support philosophy – especially the mean time between failures goal.

1. Is your error reporting as specific as possible? Avoid trapping multiple errors through the same register without having another one that gives more information.

2. Did you consider system needs when handling errors? Avoid creating limitations on system error diagnosis.

3. Did you incorporate maintenance features, such as data turn-around at key points in the logic?

4. Does your product have a fail-soft capability?

5. Are the diagnostics adequate for field service needs?

6. Are your specs complete and up-to-date?

7. Will your hardware react reasonably to common operator errors?

8. Does the documentation tell how to avoid such errors?

9. Did you use the *Digital* spec for your parts, not the supplier's spec? If the supplier's spec is different from the Digital spec, you may unconsciously rely on that difference. It is entirely possible that we will substitute another part that meets the Digital spec but won't do the job.

10. Is the site preparation documentation adequate? Did you give information on power surge, heat dissipation and electromagnetic interference?

11. Are the cables in either the option or the interface print set?

12. Were your vendor purchases made with an internal spec and design cycle to make sure we know what we are getting and we know how to fix it?

13. Are high-voltage terminals covered up so we avoid burns?

3.11 COURSE DEVELOPMENT (Prime contact: Mike Odom)

When Should You Contact Course Development?
Early in design development.

What Course Development Can Supply an Engineer
Complete educational package to train field service and other support personnel to properly maintain and support the engineer's product. Training is also given to customer students. Interfacing with the course developer, rather than with all instructors minimizes interruptions for education functions.

What Course Development Needs from an Engineer

1. Documentation
2. Consultation
3. Maintenance philosophy
4. Expected market quantities

Close working relationship, with early access to documentation helps course development progress smoothly. Technical critique assures accuracy of materials.

Management Tools that Help Make this Relationship
Recognition that the engineer should contribute to the educational package that supports the product.

3.12 INDUSTRIAL PACKAGE ENGINEERING (Prime contact: James Lawrence)

When Should you Contact Industrial Package Engineering?

1. During budget planning.

2. During mechanical packaging of components and thereafter.

What Industrial Package Engineering Can Supply an Engineer

1. Make sure the distribution function is well taken care of.

2. Make sure packaging cost can be minimal.

3. Help determine and design packages for rack-mountable add-on or OEM equipment. This enables a product to be shipped after DEC Standard 102 tests have been completed.

4. Design special pallets, if required.

5. Critiques and recommendations on vendor packing, if desired.

6. Aids and designs interplant packaging, as needed.

What Industrial Package Engineering Needs From the Engineer

1. Money (typical budget: $5 to 7K).

2. Projected quantities.

3. Definition of *all* parts that need packaging.

4. Manufacturing or flow plan for all materials.

5. As much information as possible about customers who will receive the product. For example, if we will never ship less than quantities of 100 in units of 10, we can save from $150K to 500K per year in shipping charges and packaging material.

Management Tools That Help Make this Relationship
DEC Standard 102.

3.13 RELIABILITY ENGINEERING (Prime contact: Donald Dawes)
Reliability Engineering is an organized engineering discipline using specialized techniques to make products more reliable. By reducing the number of failures in a product, we can:

1. Lower ECO activity.

2. Decrease amount of manufacturing testing.

3. Cut warranty costs.

4. Stock fewer spares.

5. Decrease field service manpower and dollar requirements.

6. Give customers more satisfaction and a better value.

When Should You Contact Reliability Engineering?
At inception of planning for a new product.

What Reliability Engineering Can Supply an Engineer

A Reliability Prediction – From a projected parts list and the known failure rates for these parts, they can make a mean time between failures (MTBF) prediction for the final product. This prediction does the following:

1. It shows what we can expect for an MTBF, if parts behave as experience has shown, and if there are no design errors.

2. It gives an early indication as to whether the product is even remotely likely to meet the product specifications.

3. It gives a baseline prediction to compare progress against.

4. It gives decision-tools for production strategy.

5. It underscores poor parts applications.

6. It helps in making business decisions (e.g., size and type of service organization, type of warranty) but it should not be used as an advertising tool.

The initial prediction may be made by the reliability engineering group. The detailed prediction is done by the designer with help from reliability engineering if necessary.

Reliability Maturity Test – The reliability engineering group has developed a test called a Reliability Maturity Test. Conducted by the reliability engineering group with the assistance of the product design group and the product manufacturing group, it certifies that the new design is ready for production. The test is conducted with prototype units to prove the design. It is repeated with early production units to check out the manufacturing system. Figure 3-2 illustrates how this test affects engineering and manufacturing.

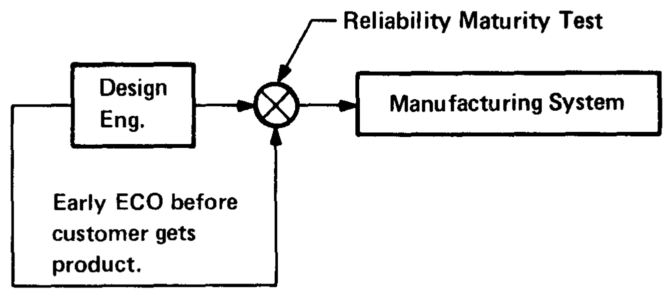


Figure 3-2 Reliability Maturity Test

For the engineering prototype, it measures whether the design is good and the parts are properly used. Long tests under controlled, realistic environments, with a large sample size (usually ten units) control:

Temperature
Humidity
Voltage and frequency
Combinations of the above

Sufficient test experience is accumulated to measure the MTBF to a confidence level of 90%. This measured MTBF can be compared to the product specification. The tests are largely functional, utilizing existing diagnostics and exerciser software. For the early manufacturing testing, they check:

1. Whether the manufacturing process has caused a problem.

2. Whether we should change the design to facilitate manufacturing, change the manufacturing process, or impose additional inspection or test.

Infant Mortality – They are studying mortality in products to:

1. Understand what factors affect the time it takes a newly-fabricated product to reach the low constant failure rate inherent in its design.

2. Help manufacturing and engineering groups to develop production test strategies that ensure that the customer receives a product free from latent defects.

3. Discover process-induced problems in specific products so the infancy period can be reduced.

Consultation in Statistical Engineering – They will help you write a test plan so that your results are statistically significant, checking:

1. Sample sizes.
2. Data analysis and interpretation.
3. The way the equipment is stressed.

What Reliability Engineering Needs From an Engineer

1. Scheduling: Product development schedule with milestones, particularly when hardware is available for test.

2. Money: Initial Reliability Estimate: $0–1000
   Reliability Maturity Test: $10,000–20,000

3. Product Specification

4. Design Specification

5. Hardware with software exerciser or diagnostic for test and operator assistance.

6. Technical assistance in diagnosing and correcting failures inversely proportional to product goodness.

Management Tools that Help Make This Relationship
None.

3.14 ENVIRONMENTAL TESTING (Prime contact: Frank Grimaldi)

When Should You Contact Environmental Testing?

1. Early in the project, to get acquainted.

2. During development, for consultation and design assistance.

3. 6 – 12 weeks of lead time are required for prototype testing.

What Environmental Testing Can Supply an Engineer

1. Dynamic Testing (DEC Standard 102 operational tests). They concentrate on vibration performance for transportation and in-service use – from the discrete product level to the board level. They do not, however, test rack-mounted items or perform random vibration tests because they do not have equipment for such testing.

2. Shock testing. They duplicate all "102" mechanical shock tests. For this purpose, they service the packaging group and product lines that do not go through packaging.

3. Temperature/humidity testing. They have a temperature/humidity chamber for DEC Standard 102 operational tests and engineering evaluation of prototypes.

4. Support for Action Lab testing.

NOTE

Procedures for Acton Lab and in-house testing and waivers are contained in DEC Standard 102.

In addition, they help in:

5. Developing added data analysis in vibration testing.

6. Developing thermal mapping capability for modules. This is a tool for development, reliability, and troubleshooting.

7. Acting as clearing-house for current status of all environmental testing.

8. Doing analysis for "102" testing and environment tracking for vans and railroad.

9. Reporting on the tests: they can supply pass/fail, raw data, or analysis.

10. Defining test plans to meet their test specs or goals.

11. Designing fixturing to hold down equipment to be tested.

12. Troubleshooting known field problems in established products.

What Environmental Testing Needs From the Engineer

1. Money: $1.5 – 2K for engineering evaluation tests. $1.5K for "102" operational tests for vibration, temperature and humidity, and mechanical shock. DEC Standard 102 specifies budgeting for Acton Lab testing.

2. Mechanical prototypes and (in very special cases) early line items.

3. Operating support *during* the test. *This is important.*

4. Test specifications or goals.

Management Tools that Help Make This Relationship

1. DEC Standard 102.
2. Test plan or test goals.

3.15 CENTRAL TEST ENGINEERING (Prime contacts: Dennis O'Connor, ICs and Modules; Russ Feener, Units and Systems)

Central test engineering coordinates the manufacturing test functions for all manufacturing plants. They are decentralizing most of their product-specific test equipment implementation functions to plant groups.

Centralized Functions:

1. New concepts
2. New test plans
3. New test methods
4. New test process generation
5. Project cost justification
6. Tester manufacture, installation, and training
7. Product test participation.

Manufacturing Plant Functions:

1. Project Coordination

    Design
    Specify
    Implement
    Build prototype

2. Monitor tester capacity (i.e., yields)

3. Manufacturing engineering support

4. ECO update

5. Fire fighting

They divide their work into four areas:

1. Incoming inspection of ICs (here, they work with component engineering)

2. Testing at module level

3. Sub-assembly testing

4. Final system integration and test

They are developing the idea of assigning a "test strategist" to work on the manufacturing half of the two-by-two team. Test strategists are essentially project leaders for manufacturing testing. Their responsibilities include:

1. Definition of test requirements for incoming inspection, module test, subsystem test and final system test.

2. Project design, implementation, and coordination for testing in all those areas.

3. Engineering support for the product's testing.

In general, central test engineering tries to:

1. Promote unattended testing capability – Digital is growing too fast to hire enough people to test everything.

2. Design-in self-diagnosis at the unit and system level.

3. Obtain "real estate" in custom LSIs for testing purposes.

4. Push testing and diagnosis to the most cost-effective level.

5. Screen and diagnose faults at module, unit, and system levels.

6. Reduce manufacturing and field costs through improved testing.

When Should You Contact Central Test Engineering?

1. Before the budget is fixed to allocate proper dollars.

2. Before design is started to develop a test plan.

3. Before P.C. layout to ensure proper partitioning for testability and diagnosability.

What Test Engineering Can Supply an Engineer

1. A test plan developed by the test strategist.

2. Direction in how to partition for testability and diagnosability.

3. Screening to stop untestable or unmanufacturable products from going to manufacturing.

4. If engineering and manufacturing are linked in a vertical structure, they will participate in design reviews.

What Test Engineering Needs From an Engineer

1. Funding, to support an agreed-upon level of test engineering participation.

2. Product specification.

3. Product performance specification.

4. The latest module, unit, or system drawings (depending on what is to be tested).

5. Goals for product volume (top and bottom figures).

6. Engineer's estimates of manufacturing cost.

7. Attendance at monthly test engineering status reviews to assure project coordination.

Management Tools That Help Make This Relationship

1. Product spec
2. Product performance spec
3. Test plan

3.16 PROCESS ENGINEERING (Prime contact: David Widder)

When Should You Contact Process Engineering?
At least before the electronics fabrication scheme is frozen. If you want dedicated help, they need three months warning.

What Process Engineering Can Supply an Engineer
Process engineering supplies information about manufacturing and testing. They will help you make financial and technical tradeoffs on:

Circuit boards
Modules
Interconnection systems
Cable harnesses
Wiring
Wire wrap
Basic systems

They will also consult on testing at the basic system, module, and incoming levels.

They will help you understand the benefits of design constraints imposed by high-volume manufacturing. Thus, if you want lower manufacturing cost through automated manufacturing, you will need standard board sizes, machine insertable components, standard pin spacings, component spacings, test techniques, and so on. They will suggest things like using two 1/2-watt resistors in parallel instead of a single 1-watt resistor, because the 1/2-watt resistors are machine insertable while the other isn't. They will advise you on the implications of DEC Standard 030 for your product.

They will explain how Digital manufactures things. They recommend that every engineer tour our manufacturing facilities, and that every design engineer consult with them before the electronic fabrication scheme is frozen. They are always available for a few hour's consultation. In some cases, they will dedicate an engineer to your problem or project, provided you set it up in advance and give them the funds.

Process engineering is charged with overseeing the entire manufacturing process. In this role they:

1. Improve efficiency in today's world. This sometimes involves making changes in the manufacturing process for current products. When a change affects the final product, they always obtain the approval of the project engineer. When it doesn't (for example, when they change from punch to slit), they do not seek engineering approval.

2. Plan for new facilities and manufacturing methods that will be cost competitive in the future.

What Process Engineering Needs From an Engineer
To provide you with consultation, they only need your presence. If you want one of their people dedicated to your project, they need lead time and money. They also need you to appreciate the fact that sometimes a seemingly painful restriction or requirement will cause a manufacturing saving that repeats itself thousands of times each month. Be sure to ask process engineers about differences among our high-volume plants.

Management Tools that Help Make This Relationship

1. DEC Standard 030.

2. Non-Standard Board Release Form: This is required whenever you use a non-standard component, pin spacing, or board size. You must obtain manufacturing approval of such boards via this form.

3.17 ECO (ENGINEERING CHANGE ORDER) GROUP
(Prime contact: Jim Gillette)

When Should You Contact ECO?
After prints have been signed off, changes must be made through this group *only*.

What ECO Group Can Supply an Engineer
A controlled method for updating engineering design.

What ECO Group Needs From the Engineer
Complete the ECO form (known as "yellow sheet"), then:

1. Submit ECO form to ECO Committee (meets every Friday at 9 a.m.).

2. Get approval of committee or appropriate engineering manager.

3. Turn ECO over to Arthur Vartanian (ECO Group).

4. After Arthur Vartanian has handled the ECO, you will be called in to look it over and sign it off.

5. ECO Group takes care of everything from this point on.

Management Tools that Help Make This Relationship
Engineering Change Order form.

3.18 ENGINEERING LIBRARY (Prime contacts: Renate Baptiste, Mimi Cummings, Sheila Wyatt)

When Should You Contact the Engineering Library?
Any time.

What the Engineering Library Can Supply an Engineer

1. Reference books

2. Periodicals

3. Newspapers

4. Proceedings of conferences

5. Vendor product catalogs

6. Competitive files (the EPAI Program – Exchange of Publicly Available Information. Participants are: Control Data, Hewlett Packard, Honeywell, National Cash Register, Univac, Varian, XDS, and IBM).

7. File of standards and specifications (EIA, ANSI, MIL, etc.)

8. Reference copies of:

   Master Spec Status Book
   Raw materials purchase parts list
   Components index
   Basic part number order

9. Borrowing facilities at MIT library

10. Assistance with specific research projects

11. Purchase order processing for printed materials and membership dues

12. Price and publisher information

13. Engineering Newsletter (monthly) lists new material and library development

What the Library Needs From an Engineer

1. Sign out borrowed materials.

2. Return material on time (loan period is two weeks; renewal available. Longer terms can be arranged.)

Library Hours
Library facilities and services are available to any Digital employee. Full-time librarians are on duty from 7:30–5:00, Monday through Friday. They will try to assist you with any of your questions. If you care to contact them by phone, their extensions are 2339 and 3824.

3.19 COMPUTATIONAL SERVICES (Prime contact: Sid Cronsberg)

When Should You Contact Computational Services?
Any time.

What Computational Services Can Supply an Engineer

Timeshared services on CS-2 (previously known as system 40) runs 7 days a week, 20 hours a day with operator support, and one more hour without operators. Field service operates CS-2 the other three hours.

They also support all standard DECsystem-10 software, including:

FORTRAN
COBOL
MACRO-10
BASIC
ALGOL
BLISS
MIMIC (a major simulation package)

Terminal clusters are in the Mill, Parker Street, and Marlboro. Parker Street and Marlboro will soon have Remote Job Entry Stations for output of *small* printouts. Large runs will still print out in the Mill (5-B), and come on a regular delivery. Access is also available via modems.

A *CS-2 User's Guide* is available from Sid Cronsberg's secretary. An update will be printed around December, 1974. Batch input through the terminal or via CS-2 operator work requests is possible, as is terminal time-sharing. CS-2 people will copy tapes, disk packs, and paper tapes, and make listings of files.

Time is also available on other DECsystem-10s in Marlboro on a limited basis. Computational services provides facilities management for some other computer systems, such as the small software engineering systems, the design automation system, and most DECsystem-10s in Marlboro.

A *Programming Staff* is available for consultation and some limited applications programming.

Software Preparation puts hand-written material into machine-readable form. Their services include:

1. Editing for RUNOFF output. (RUNOFF is a program that allows clean-looking printouts of ASCII files.)

2. Transcription

3. Assembly/compilation

There are satellite groups in the Mill, Parker Street, and Marlboro – and a night shift in the Mill.

What Computational Services Needs From an Engineer

1. A valid discrete project number.

2. Money allocated for the purpose.

3. An individual who wishes to get onto CS-2 must obtain an access number from computational services. A user's guide is available.

Management Tools that Help Make This Relationship
None.

CHAPTER 4
HARDWARE ENGINEERING REVIEW BOARD

4.1 CHARTER FOR HARDWARE ENGINEERING REVIEW BOARD

The Board's primary goal is to formally acknowledge all competent practicing engineers who otherwise would lack credentials.

Secondary goals include monitoring and accelerating the development of technical people at, or near the entry level. The Board will approve supervisors' proposals for promotions to engineering assistant, and will establish means for giving new engineers a working knowledge of key parts of the company (e.g., manufacturing) at minimum cost in time and failure.

We *don't* concern ourselves with B.S. degree holders; they don't need our acknowledgment. Neither do we concern ourselves with the level of supervisory or administrative responsibilities that proposed engineers may be carrying; other avenues exist for recognizing those contributions.

Our concerns are with the technical knowledge and ability and the engineering growth potential of the proposed engineer – *and* we evaluate both depth and breadth.

If the proposed engineer would be accepted as an engineer by careful engineering supervisors in other companies, we feel comfortable about saying yes. But we try not to impose standards higher than equivalence to fresh young B.S. graduates. Supervisors' inputs, peer evaluations (especially from groups other than the candidate's own), and personal interviews are always included in our evaluations. Specific engineering projects are discussed and supervisors (or prospective engineers through their supervisors) are encouraged to submit projects early so the board can help the supervisor plan a significant and measurable experience.

Monthly meetings are scheduled by a formula, and every member can mark his calendar to reserve this time months in advance. The secretary will notify each member by memo two weeks ahead, or by phone one week ahead to release those members whose presence is not specifically needed by the actual agenda. Members are expected to notify the secretary with these same lead times if they expect to be unavailable because a replacement may have to be selected to be fair to candidates.

4.2 THE PROCESS OF RECLASSIFYING AN EMPLOYEE TO ASSOCIATE ENGINEER

Identification of an Employee Who Has Engineering Potential

Engineering supervisors should always be on the lookout for technicians in their respective areas of responsibility who have demonstrated potential and interest in carrying out engineering responsibility.

Initial Discussion With Employees Who Have Engineering Potential

Once a technician with engineering potential has been identified, the supervisor should have a discussion with the employee concerning his or her personal ambitions/goals and determine whether or not the employee is interested in pursuing a career as a professional engineer. If the employee is interested in professional engineering, the supervisor should explain to him or her what is expected of an engineer and outline how the employee can achieve engineering status in the company. This initial discussion should also include a review of the employee's strengths and weaknesses and determine how the employee can work on areas of performance that need improvement.

Supervisor Plans Trial Assignment

If the supervisor feels that the employee is ready, a trial assignment will be developed which must be a legitimate test of the employee's engineering ability. This may mean a temporary transfer of the employee to another department if a trail assignment is not planned in the current department. The trial assignment must be developed in detail, including what the employee's responsibilities will be, a timetable for the trial assignment, and the performance criteria that must be met.

Discussion With The Employee About The Trial Assignment

After the trial assignment has been determined, the supervisor will outline the assignment in detail to the employee. This orientation to the trial assignment will include how the employee will be measured while performing the trial assignment, the documentation required, and a timetable for periodic reviews of the employee's progress by the supervisor during the trial assignment.

Preparation of Material for Engineering Review Board

Upon the employee's successful completion of the trial assignment, the supervisor will prepare a proposal to the Engineering Review Board requesting that the employee be considered for reclassification to associate engineer. This proposal will include:

1. An outline of the employee's overall qualifications:

   Education level
   Experience prior to Digital
   Experience within Digital

2. Outline the trial assignment. What was it? What was the goal?

3. What were the specific performance requirements and time schedules of the assignment, and specifically, how well did the employee perform against these requirements and time schedules?

4. What are the employees strengths? What is the assessment of his or her potential? Specific areas to be strengthened by schooling or other more sophisticated assignments should be outlined.

5. This proposal and supporting information should be forwarded to the appropriate personnel manager. The personnel manager and the engineering manager/supervisor review the material and jointly determine with the supervisor whether the employee meets the minimum requirements of the position of associate engineer. This may include a meeting with the technician and the personnel manager, or the engineering manager and the employee's supervisor.

When it is determined that the employee has met all of the requirements to be reclassified to associate engineer, the personnel manager will forward a copy of the proposal to the secretary of the ERB for inclusion on the next meeting agenda. Copies of the proposal will be forwarded to the ERB members in advance of the meeting.

Review By The Engineering Review Board

The supervisor will be scheduled to appear before the Board once the Engineering Review Board members have reviewed the proposal to reclassify an employee to associate engineer and are satisfied that the employee merits consideration by the Board. The supervisor will be asked to discuss the employee's technical performance on the trial assignment in detail, as well as the overall qualifications of the employee and his/her potential to advance in the engineering field. From this discussion, the ERB will reach a decision on the proposal.

The supervisor is then informed of the Board's decision. If the Board's recommendation is favorable, this recommendation is forwarded to the Salary Review Committee for final review and approval. If the Board's recommendation is unfavorable, a written report is provided to the supervisor outlining the reasons why the request was rejected and suggesting corrective action be taken.

The employee does not have to appear before the ERB in this phase of reclassification.

APPENDIX A
OFFICE OF DEVELOPMENT
ORGANIZATION CHART

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     Updated: 10/10/74
      G. Bell

VICE PRESIDENT, OFFICE OF DEVELOPMENT (Gordon Bell)
!
!....PERSONNEL (Mark Abbett)
!    !----Software Senior Representative (open)
!         !----SOFTWARE PERS. REP. (Joe Underwood)
!    !----PERIPHERALS SR. PERS. REP. (Jerry Patton)
!    !----COMPUTER SYSTMS PERS.REP. (Dave Larson)
!    !----ADMINISTRATOR (Theresa Buckley)
!    !----PERSONNEL SERVICES ADMINISTRATORS
!         PERIPHERALS PSA (Jan Rodil)
!         SOFTWARE PSA (Patty Mercury)
!    !----CENTRAL RECRUITING SUPVR. (open)
!         !----Recruiter (open)
!         !----Recruiter (Leo McKiernan)
!         !----Associate Recruiter (Susan Coffey)
!         !----Associate Recruiter (Randi Love)
!
!----FINANCE (Phil Laut)
!    !----Planning (Al Sharon)
!    !....EDP (Arnie Goldfein)
!    !....SOFTWARE ANALYST ( Pat Spratt)
!    !....HARDWARE ANALYST (Irene Leary)
!    !....SYSTEMS ANALYST (Larry Smith)
!
!----CHIEF ENGINEER (Dick Best)
!    !----DESIGN REVIEW (Carl Noelcke)
!----TECHNICAL STAFF (vacant)
!....MEMORIES (Henry Lemaire)
!....COMMUNICATIONS OPTIONS (Vince Bastiani)
!....TERMINALS (Tom Stockebrand)
!....PDP-10 (Fred Wilhelm)
!
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!----VICE PRESIDENT, SOFTWARE DEVELOPMENT (Larry Portner)
!    !----MANAGER, SFT PRODUCTS GROUP Mgr. (Mel Woolsey)
!         !----MULTI-USER SOFTWR.Prod. Mgr. (Dick Angel)
!         !----REAL-TIME SOFTWR. Prod. Mgr. (Claiborne Neal)
!         !----LANGUAGES & UTILIITIES Prod. MGR. (Al Brown)
!         !----SMALL SYSTEMS SOFTWR. Prod. Mgr. (open)
!         !----SOFTWARE POLICIES Mgr. (Jim McKinley)
!    !----MGR. PDP-11 SOFTW.ENG. (Pete Van Roekens)
!         !----SMALL SYSTEMS SOFTWR ENG. (Ken Ellson)
!         !----LANGUAGEs (P. Van Roekens, acting)
!         !----NETWORK+Real Time (Frank Hassett)
!    !----DECSYSTEM 10 Softw. Eng. (Peter Conklin)
!         !----Decsystem 10 MARKET S.E. (J. Singer)
!         !----Decsystem 10 S.E. (C. Turley)
!         !----DECSYSTEM-10 LANG. PRODUCTS Mgr. (Jim Mills)
!    !----Mgr. Software APPLICATIONS (Ed Fauvre)
!         !----TYPESET-11 Prod. Sys. Dev. (T. Donovan)
!    !----Software Engineering  Support Mgr. (Bill Slack)
!          !----European Software Eng. Mgr. (Cary Wyman)
!          !----Software Documentation Mgr. (Bob Gafford)
!         !----SOFTWARE STANDARDS Mgr. (Pat White)
!         !----Hrdwr./Softwr. Tools Mgr. (John Xenakis)
!    !----RESEARCH & Dev. Mgr. (Jim Bell)
!         !----ADVANCED SYSTEMS RESEARCH Supr. (Bill Strecker)
!         !----SYS. TECH. & MEASUREMENT Supr. (Rollins Turner)
!    !----Administration & SERVICES Mgr. (Oleh Kostetsky)
!          !----Operations Analysis (Don Crowther)
!          !----Sftwr. Distribution Center (Tom Mullane)
!          !----MIS Systems, Cent. Admin. Doc. Svco. (Roy Lightfoot)
!    !----Diagnostic ENGINEERING Mgr. (George Plowman)
!          !----Automated Mfs. (Marv Horovitz)
!          !----PRODUCT LINE Diagnostics (Walter Manter)
!          !----STANDARDS & SYSTEMS (George Plowman, Acting)
!    !----Software Planning Mgr. (Larry Wade)
!          !----Departmental Planning Mgr. (Ed Wright)
!         !----HIRING & TRAINING Mgr. (Jim Murphy)
!    !----Networks Program Mgr. (Nat Teichholtz)
!    !----PERSONNEL MGMT. DEV. (open)
!    !----FINANCE (Pat Spratt)
!    !----SOFTWARE RELIABILITY ENG. Mgr. (Jack Mileski)
!
!
!----VICE PRESIDENT, COMPUTER SYSTEMS (Dick Clayton)
!    !
!    !----PDP-8 DEVELOPMENT Mgr. (John Clarke)
!         !----PRODUCT SUPPORT (Dave Brown)
!         !----8/A PROJECT ENGINEER (John Kirk)
!    !----SMALL PDP-11 SYSTEMS (Steve Teicher)
!         !----T↑2L 11/05's Supvr. (John Sofio)
!         !----RELIABILITY (Richard Olsen)
!         !----PRODUCT SUPPORT SUPVR. (Doug Rothenberg)
!         !----LSI (Dick Spencer)
!         !----MOS SYSTEMS (Mike Titelbaum)
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!    !----MEDIUM & LARGE 11 SYSTEMS (Bill Demmer)
!          !----LARGE 11 SYSTEMS Mgr. (Al Ryder)
!              !----Product Mgmt (John Misialek)
!              !----11/45 Supvr. (Bob Kirk)
!              !----MEMORIES (Sas Durvasula)
!              !----TECHNOLOGY (Dave Potter)
!              !----NEW SYSTEM(Steve Rothman)
!         !----MEDIUM 11 SYSTEMS Mgr. (Jega Arulpragasam)
!              !----PRODUCT PLANNING (Bob Gray)
!              !----11/40 (Jega Arulpragasam, acting)
!              !----NEW SYSTEM(John Levy)
!         !----11 FAMILY PACKAGING Mgr. (Dick Gonzales)
!         !----11 FAMILY SYSTEM ENG. Mgr.  (Ralph Platz)
!              !----ELECTRICAL RELIABILITY (Don Vonada)
!              !----SYSTEM TESTING (Ray Archambault)
!              !----SYSTEMS SUPPORT (Ed Permon)
!              !----SYS. DIAGNOSTICS & AVAIL.(Rick Fadden)
!    !----LARGE MINIS Mgr. (Bruce Delagi)
!         !----PRODUCT MANAGEMENT (Al Avery)
!         !----SYSTEM DESIGN (Len Hughes)
!    !----MKT. SERVICES, DEVELOPMENT Mgr. (Bill McBride)
!         !----TECHNICAL LITERATURE (Roger Dow)
!         !----PROMOTIONAL
!         !----COMPETITIVE PRODUCT EVALUATION
!    !----SYSTEMS PLANNING INTEGRATION (Robin Frith)
!    !----FINANCE (Larry Smith)
!    !----PERSONNEL (Dave Larson)
!
!
!----VICE PRESIDENT, HARDWARE DEVELOPMENT (Bob Puffer)
!    !
!    !----DISK ENGINEERING (Grant Saviers)
!          !----PROJECT MANAGEMENT
!          !----PLANNING & PRODUCT Mgr. (Paul Badum)
!         !----RP04 (Steve Orr)
!    !----TAPE ENGINEERING (Bob Peyton)
!          !----PROJECT MANAGEMENT
!          !----PLANNING & PRODUCT Mgr. (Paul Bauer)
!    !----LA36, UNIT REC.I/O (Ed Corell)
!          !----PROJECT MANAGEMENT
!          !----PLANNING AND PRODUCT Mgr. (Al Huefner)
!    !----LSI ENGINEERING (Lorrin Gale)
!          !----TOOLS (Bob Kusik)
!          !----CHIP DESIGN
!    !----POWER & PACKAGING (open)
!          !----POWER SUPPLY ENGINEERING Mgr. (Paul Rey)
!          !----MECHANICAL & INDST. DESIGN Mgr. (Dave Nevala)
!    !----ENGINEERING SERVICES (Phil Tays)
!          !----MODEL SHOP Mgr. (George Gerelds)
!          !----DESIGN SERVICE Mgr. (Leo Bennett)
```

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!               !----DRAFTING Mgr. (Dick Reilly)
!               !----CAD DEVELOPMENT Mgr. (Ed Vrablik)
!               !----CAD OPERATION Mgr. (Jack Murray)
!           !----INFORMATION SERVICES (Jim Gillett)
!          !----INFOR. PROCESSING & CORP. NETWORK DEV. MGR(Ron Rutledge)
!     !----FINANCE (Irene Leary)
!     !----PERSONNEL (Jerry Patton)
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BELL

digital

engineer's orientation manual

company confidential
january 1978

office of development
digital equipment corporation
maynard, massachusetts 01754

digital

engineer's orientation manual

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1st Edition, January 1978

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Printed in U.S.A.

This document was set on DIGITAL's DECset-8000 computerized typesetting system.

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FIGURES

PREFACE

The New Engineer Orientation Manual is addressed to you, a new employee at DIGITAL. We have assembled the information we feel will help you become familiar with DIGITAL's structure and philosophy. Our primary objective is to convince you of the importance of: (1) individual responsibility at any level since decisions are pushed down to the lowest level where all the information is available, (2) open communication and direct interaction between people in any organization at any level of responsibility, and (3) encouragement of creative ideas that come from people everywhere within the corporation.

A summary of most of the organizations at DIGITAL provides you with a "tool" which you can use in determining WHAT is going on, WHO you should contact with respect to your current needs, WHEN you should establish contact with the responsible people and HOW you can develop a good relationship with the individuals with whom you will be interfacing.

Information is not included on how your own group works internally or on local groups that are common to all organizations, such as Payroll and Personnel. You should ask your secretary or supervisor about these functions.

This book is intended to describe how DIGITAL works today, not someone's dream of how it might work. You are invited to forward your experiences which are different from those described and/or any areas of endeavor which have been omitted to Allan Kent, ML4-4/E99, so that we may improve and update this manual.

An overall flow of the "Life of a Project" from its inception to completion supported by individual charts of specific groups and the role they play within inherent time frames is presented in Chapter 2.

References to information that may be of value to you in performing your job with instructions on where and how to get it is provided in Chapter 4.

Charts of the organizations described in Chapter 3 are contained in Appendix A.

You are not expected to, nor is it necessary for you, to read this manual in its entirety. Your need for specific information will determine which sections of Chapters 3 and 4 you should read. Chapters 1 and 2 are immediately useful in bringing you on-board.

CHAPTER 1
CORPORATE PROFILE

Orientation means to familiarize with or adjust to a situation; it also means to align or position with respect to a specific direction or reference system. DIGITAL's structure, philosophies, values, and management "style" constitute the focal point to which you as a new employee will converge in a common goal to grow and prosper. The information assembled in this manual is to help you understand DIGITAL, what is expected of you, and what you should expect from others.

Before you select specific sections to read that may be of immediate interest to you, take a few minutes to read the following excerpts from a speech given to an engineering group by DIGITAL's founder and president, Ken Olsen.

> *"Sometimes we don't fully appreciate the importance of keeping our mouth shut because any one thing doesn't look all that significant. But altogether, things are really important. Any time we, as a company are so open and talk about or write about company matters, we invest heavily in communication. Don't communicate with neighbors in your community about company matters; there is just too much information about what we do at DEC that reaches people outside the corporation.*
>
> *"Everything is a compromise and we ought to consider every decision we make as a meaningful compromise. The whole art of engineering is compromise. Therefore, engineers of all people should be best at compromising. Often, however, they have the worst time in making compromises. You can't build a bridge, or an airplane, or a computer that's absolutely safe in every alternative. It would take forever, cost an infinite amount of money, and there wouldn't be enough weight left for cars on the bridge, you couldn't get off the ground in the airplane, and you couldn't meet your schedule.*
>
> *"There is no absolute safety. We're professionals, we can't get away with saying 'I will go all the way, one way and be safe.' We must find the best compromise and then live with the ensuing criticisms. We just learn by our mistakes and do better. That's what we're paid for in our profession. There is a list of things in which we must compromise and identifying them, I think, will help us face the issue.*
>
> *"The first area of compromise is in new technology. The only time we claim that we've ever been ahead of technology is the day we opened our doors and we've been behind ever since. There are a number of reasons for this. When we started, we had a handful of technology. After that we had to live with our previous product and with our customers who dictated what they wanted. In general, they didn't care about technology. They wanted the products to continue, they had problems to solve and that is what they were interested in. Compromises come because in the long run they use technology that gives the best product, the best solution to problems, the lowest price, and the best reliability. We must always face that.*
>
> *"A few years ago, the world was promising great things in integrated circuits. The professors at MIT were promising then what we can just do today and the world hated us because we said it wasn't ready yet. We were the last ones to use integrated circuits, and then we were 6 months early! The argument that showed we were right said that we paid 60 cents per unit while others paid 4 dollars per unit because they started earlier than we did and their product was therefore that much more expensive.*

"A few years ago, one of our development managers was very excited about magnetic bubbles. 'You can't lose,' he said. 'We must jump on the bandwagon; we must be a leader or we'll lose out'. Even Gordon Bell said it was coming soon. We were reluctant to offend that development manager because he was so enthusiastic, but we said 'no.' Well, five years later, it doesn't look like we've lost all that much. Waiting until we're sure has been a good policy. On the other hand, you can't survive by saying 'no' to all new technology.

"The second area of compromise is merely red tape which includes scheduling and budgeting. Our engineering departments terrify me because I think we're training hundreds of people to be budgeters and schedulers and after awhile they'll all forget how to be engineers. Budgets and schedules are tools; they are not used instead *of engineering. We've got to use them but that's all they are, just tools. We are engineers, and we are only useful as long as we're doing engineering.*

"A third area of compromise is safety. There are many things that fail for which there is no excuse. We just really work to cover all the alternatives. Projects shouldn't fail. In some areas there is no excuse for failure; the compromise comes in because you can't make everything absolutely safe.

"In engineering there are no excuses. It has to work. I sat at IBM for a year, which was the worst year of my life. I didn't have much to do, but I learned a lot there. I was representing MIT and the Air Force and I had to make certain the products were done right. I could nail them because they didn't have technical analyses on the steel racks, but I couldn't tell them to start at the joints because that wasn't in the requirements. I decided that all the people there were really making a list of reasons to show that if any failures occurred it wasn't their fault.

"We can't do that! We have to get the job done, make sure it succeeds and realize there is always some chance of failure. We mustn't make a list of reasons to show that if something goes wrong it wasn't our fault. When we schedule projects, the normal tendency of an engineer is to schedule the test point two years away; postpone the day of failure for two years. That's just not healthy. I have often thought I wouldn't hire my son at DIGITAL. I think if I did I would have him go into our Computer Special Systems organization because they succeed or fail every month and learn from it. We should make all our mistakes easy ones, our failures small and have them come early, so we can learn.

"The fourth area of compromise that I worry about in modern engineering is the amount of time that people spend preparing presentations for marketeers (when they're not budgeting or scheduling). Let me tell you how it looks to an outsider. A group of engineers studies something, they think about it for months and they look at it from every angle. They know as much as can be known. They know exactly which way to go. But, either because they are cowardly and want someone else to take the responsibility for their decision, or for some mysterious reason I can't explain, they make massive presentations to marketing people and lay the question before them. Now the marketeers have never thought about the subject before, they don't even know what the initials mean. When engineers ask them for a point of view they get back from 100 people 100 points of view that become 1,000 points of view before the meeting is over. Because engineers have a project on which they don't want to do engineering, they'll work two years budgeting and scheduling, they won't do any work, won't read a magazine, won't look at a book, nor a catalogue and won't draw up our diagrams; because they won't do any real work until they have this 'buy-in' from marketeers.

"I can't explain the logic behind this, because by the time the project is done, those marketeers have gone somewhere else. Even if they are still here when the project comes out, they've forgotten what they said. Thus, there is no such thing as 'buy-in.' You can't accomplish what you want if you want marketeers to buy-in. If you want their point of view, lay out what you want at the beginning, what you know is right. If they have any thoughts on the matter whatsoever, they'll speak up. If they don't, they haven't thought about it anyway, so there is no point in getting together in a big room.

"Another area of compromise comes in discipline. We follow sort of the New England tradition of revolutionary soldiers. We look and behave like rebels. We think we won the Revolution because the British soldiers marched in straight rows, fired their muskets in unison and never aimed, while the smart Americans fired at random from behind trees and stone walls. The real story is that whenever the British started shooting back, the Americans just ran. The whole fight that we're so proud of in Concord was one

big mistake. The Americans were so undisciplined and disorganized they got the whole thing started by mistake. The Colonial rebels really didn't win until they hired some European officers who taught them how to march in straight rows, shoot on command, and stand their ground when the other side shot back. When they finally got discipline, they won the war.

"You can take all these great stories on discipline with a grain of salt. Complete discipline would be too much of course. It's a compromise. No discipline whatsoever and there's never any production at all. We have to have discipline in our organization, our lives, our way of doing things. Compromise comes in because too much, by definition, is too much.

"Another area of compromise is in management. Managers must always compromise. They can go to extremes. One extreme is to do it all themselves. The problem with this is that we can't get them to do anything right, because the projects have to stay small so they can do everything themselves. It frustrates the people working for them. It frustrates the boss. Nothing happens until he gets around to it. He's not a manager at all. The other kind of manager who maybe is even worse, abandons everything. Between these extremes comes the compromise. Managing is playing that compromise. The manager must realize this and always face it. There are all kinds of tricks you can use to help. One is to require people to schedule all their work and then submit reports. The preparation of these reports will, in fact, force people to compile and review the information they need to do their job. When something falls apart, you know it and can talk to the people who are in trouble. Engineering sometimes takes forever, but it always comes out. Those things we watch get done, and those we don't watch never get done. It's one of the tricks. Another trick to managing is to threaten people that you might do the job better than they.

"I had lunch with the editor of one of Boston's big newspapers and had been critical of him. As we were walking out he asked, 'Do you ever have trouble motivating these 30-35 year old people?' I said, 'Our trouble is we can't get them to go home!' My frustration with that newspaper is that the reporters don't know what they are doing. They report freely but don't know what they are writing about. I figured out what that editor should do. If he would say, 'Let it be known that every month I am going to become an expert on a new subject' but not tell anybody what those things were, it would change the whole organization.

"We used to work for Jay Forrester, one of the real pioneers in computers. We called his style pulse management. He would come in with one pulse. Pulse management can keep people on their toes because they can't ever tell when you're going to come down and pulse them and know more than they do. It keeps the whole outfit sharp! They had better be awake!

"The other area in working out this compromise is to delegate. Of course you can't abandon a project either or nothing happens. One technique is to read a little about warfare. If you are an officer charged with defending a position, you go by every hour and check every single machine gun and the troops manning them. You make sure your men are not dead, that they're not sleeping, or sick; that they haven't run away. You make sure they're ready every hour. There is no such thing as losing the position and then saying, 'Well, things seemed okay when I checked yesterday.' When you're a manager, you have to manage so that you know everything that is going on. There is no such thing as, 'I trusted so and so and he let me down.'

"What happens to middle aged people? In general, they want to get into management. Engineers want to retire from engineering. I think maybe society has forced us into doing that, and engineers ought to fight it. It's okay to be a manager; the company depends upon the availability of good managers. But we should never become managers because we want to 'retire' and get an easy job. There are no easy jobs. You ought to fight the temptation to retire and always take the hard jobs. Always work hard at it and when you become 40 or 50 you'll be in demand. During the last recession, many people in Massachusetts who were 45 and 50 were looking for jobs. They thought they couldn't find work because they were too old. I interviewed a number of them and consistently they said that they used to be engineers, or draftsmen, or machinists. But they got promoted into some administrative work for which they were paid very well. But now they couldn't find work. The secret of it, I think, is always to be something. Don't be a nothing. Be in demand. The interesting thing is that our society wants us to be promoted into a do-nothing administrative job. Be someone who's been something for 45 years and work hard at being GOOD at what you do."

1.1 OVERVIEW

Digital Equipment Corporation is the world's leading manufacturer of minicomputers, second in total computer installations with over 90,000, a leader in timesharing and interactive computing, and the foremost maker of logic modules. A Fortune 500 company, DIGITAL employs more than 36,000 people in manufacturing, engineering, sales, and service locations around the world. DIGITAL's growth can be attributed to its continuing commitment to provide increased performance at a lower price. Since the company's beginning in 1957, this commitment has been good for DIGITAL and good for its customers: DIGITAL's first computer, the PDP-1, broke the million dollar barrier in 1960, providing interactive computing capability for about $125,000.

DIGITAL's first minicomputer, the PDP-5, lowered the cost of interactive computing to about $25,000. (Its current day equivalent costs less than $2000!)

DIGITAL's computer systems revolve around three central processor families:

- The PDP-8 was first used as a laboratory tool. Today it functions in machine control, process control, real-time monitoring applications, and a host of business and commercial applications. In number of installations, the PDP-8 is the most popular computer ever produced.

- The PDP-11 brought new technological advances to small computers. Encompassing the broadest range of compatible processors, peripherals, and software ever offered, PDP-11 systems are used for everything from running a lathe to running a railroad.

- The DECsystem-10 was the first commercially available timesharing system designed to simultaneously handle timesharing, batch, remote job entry, and real-time tasks. DECsystem-10s are used by more data service companies to provide timesharing services than any other system. The DECSYSTEM-20, a smaller version of our large computer capability, bridges the gap between the DECsystem-10 and the PDP-11.

To support this line of processors, DIGITAL manufactures a full line of peripheral equipment – including disk and tape systems, input/output devices, hard copy and video terminals, and communication interfaces. This large selection of peripheral equipment allows DIGITAL customers to tailor systems to meet today's specific needs, with the assurance of expansion capability for tomorrow's requirements.

Complementing the hardware offering, DIGITAL provides software products such as application packages, operating systems, higher level languages, and utilities. These products bring the full capability to meet its commitment of increased performance at a lower price.

Possibly more important, DIGITAL provides resources and services to support all its products.

- Software consultant services range from getting a specialized system up and running to writing custom application programs.

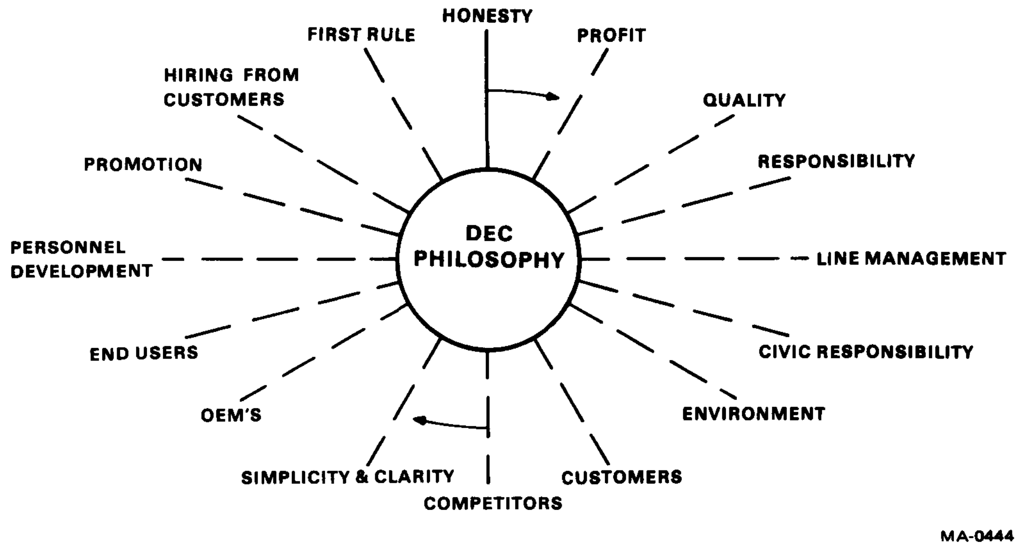
- A hardware maintenance group of more than 4,000 engineers worldwide is available to service and perform preventive maintenance on all DIGITAL computer systems.

- Sales, Software Support, and Field Service representatives provide sales and service from more than 350 locations in the United States and more than 35 foreign countries.

- Over 100 computer-related courses are available to all DIGITAL customers at worldwide training sites.

- DECUS, the Digital Equipment Computer Users Society, the largest such group in the world, sponsors symposia, publishes newsletters, and administers a program library for its members.

1.2 DIGITAL PHILOSOPHY



DIGITAL philosophy as represented by the following statements reflects the kind of company DIGITAL prefers to be to its employees and to the outside world on a perpetual basis, exemplified via the Perpetual Clock above.

HONESTY
We want to be not only technically honest, but also to make sure that the implication of what we say and the impressions we leave are correct. When we make a commitment to customers or to employees, we feel the obligation to see that it happens.

PROFIT
We are a public Corporation. Stockholders invested in our Corporation for profit. Success is measured by profit. With success comes the opportunity to grow, the ability to hire good people, and the satisfaction that comes with meeting your goals. We feel that profit is in no way inconsistent with social goals.

QUALITY
Growth is not our primary goal. Our goal is to be a quality organization and do a quality job which means that we will be proud of our product and our work for years to come. As we achieve quality, growth comes as a result.

The product we are selling includes the engineering, the software, the manufacturing, and the services, which include Field Service, Software Support, Sales, Order Processing, Training, and manuals.

RESPONSIBILITY
Plans are proposed by managers or teams. These plans may be rejected until they fit Corporate goals or until the Operations Committee feels confident in the plans. But when they are accepted, they are the responsibility of those who proposed them. The impetus for the plan may come from outside the group making the proposal, but when it is accepted, the proposal is the responsibility of the one who proposed it.

LINE MANAGEMENT

We particularly want to be sure that line management jobs are clear and well defined. Because so many people are dependent on the plans of line managers, it is very important that the plans have regular automatic measurements built into them. Meeting financial results is only one measure of a plan; other measures are satisfied customers, development of people, meeting long range needs of the Corporation, development of new products, and opening new markets. We believe that our commitment to planning assures our freedom to act.

SOCIETY

We are committed as a Corporation to take affirmative action in providing equal opportunity for employment and promotion for all persons regardless of race, color, creed, or sex. We encourage all employees to take responsibility in community, social, and government activities. We are always open for proposals as to what the Corporation or an individual on Corporation time may want to do in these areas. However, activities done on Company time or with Company funds should have a formal proposal including ways of regularly measuring success toward goals.

ENVIRONMENT

As good citizens we have a responsibility to keep our environment free of pollution and to set an example.

CUSTOMERS

We must be honest and straightforward with our customers and be sure that they are not only told the facts, but that they also understand the facts.

To the best of our ability, we want to be sure that the products we sell answer the needs of the customer even when that customer is too naive to understand these needs exactly. When we sell a product to a customer, we want to be sure the Corporation fulfills the obligations we took on with the sale. We sell our Corporation, not a single individual, to our customers and we must be sure all DEC commitments are met.

COMPETITORS

We never criticize the competition publicly. We sell by presenting the positive features of our own products. We want to be respectful of all competition, and collect and analyze all public information about competitors. When we hire people from competitors, we should never press them for confidential, competitive information, nor should we use confidential literature they may have taken with them.

SIMPLICITY AND CLARITY

We want all aspects of DEC to be clear and simple and we want simple products, proposals, organization, literature that is easy to read and understand, and advertisements that have a simple, obvious message. We have thousands of employees and many thousands of customers. We have to keep things simple to be sure that we all work together. Our decisions must always consider the impact on the people who will be affected by them.

OEMS
Standard products are the base of our business. At times, in certain areas, we will invest in software and hardware specifically for special markets. But we should never lose sight that the base of our business is our standard products.

We are very dependent on selling to OEMs. There are more applications for our products than we could ever develop. In addition, there are many risks to be taken in developing new fields which we cannot afford. We therefore are very dependent on OEMs, and when they take the risks and they are clever enough to be successful, we should be most respectful of their risks and their effort. When our OEMs are in trouble with a customer, we should tell them.

PERSONNEL DEVELOPMENT
We encourage people to develop technical skills, breadth of knowledge, and expertise in a specific area. We also encourage people to develop supervisory and management skills. We believe that individual discipline should be self-generated.

PROMOTION
We promote people according to their performance, not only their technical ability but also their ability to get the job done and to take the responsibility that goes with the job. Ability is measured not only by past results, but also by attitude and desire to succeed. Performance results are also used to decide whether a person should remain in his or her current job.

HIRING FROM CUSTOMERS
We should be exceedingly careful when hiring employees from customers. Sometimes this is reasonable and desirable; but we should do it with all caution and by being sure that the employee first tells the customer and allows the customer the chance to compete against us.

FIRST RULE
When dealing with a customer, a vendor, or an employee, do what is "right" to do in each situation.

1.3 DIGITAL STRUCTURE
DIGITAL operates on a matrix structure which is not used by many companies and, therefore, most people are not familiar with how it works. Briefly, a matrix organization is one in which many members are responsible to more than one person. It is designed to provide checks and balances in decision-making as well as to ensure that major proposals receive full exploration from all interested parties. The matrix organization is one of DEC's greatest strengths which makes it possible to view the overall business from a variety of viewpoints. For example, it is possible to look at a single product across Product Lines from an Engineering or Manufacturing viewpoint. Sales can be viewed worldwide by Product Line. A single country or region can be examined across functions and Product Lines. Product Lines can develop and market products using the resources of Engineering, Manufacturing, and Field Service organizations.

A matrix organizational structure requires people from all areas of the corporation to communicate, work together, and see one another's viewpoints. Employees feel responsible for more than one aspect of the business.

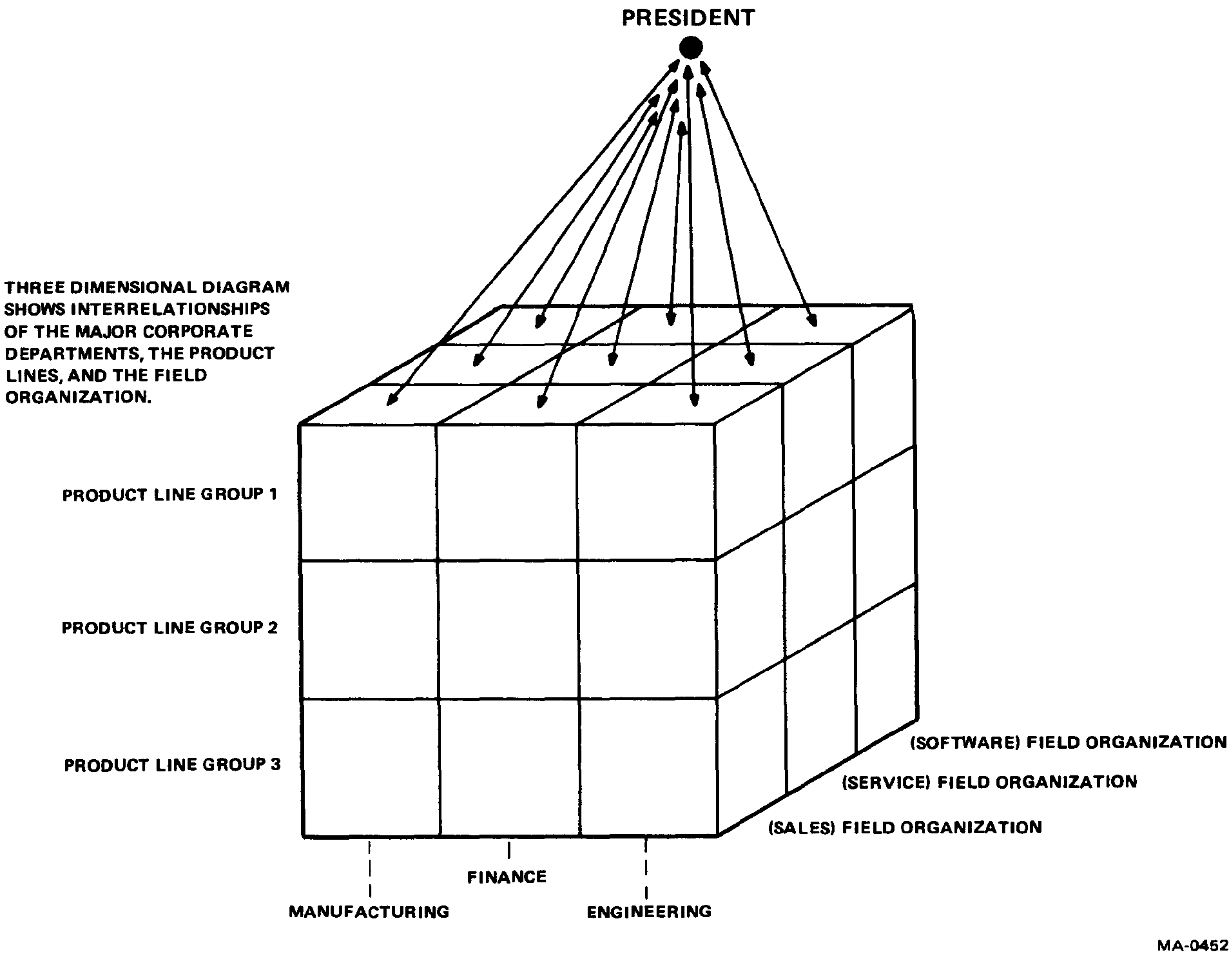


Figure 1-1 shows another interpretation of DIGITAL's matrix structure, highlighting major areas of involvement between people within the four major divisions: Engineering, Manufacturing, Product Lines, and Sales (Field Organization). Chapter and paragraph references are included in the figure indicating those sections of text providing more detail.

Engineering performs product development according to plans agreed upon with Product Line Marketing. Engineering also performs advanced development, providing a high degree of technical specialization in Printer, Computer Systems, and Software Engineering, major corporate processes, and research to maintain DIGITAL as a major competitive factor in the marketplace. Engineering Services, Documentation Control, and Purchase Specifications are provided in support of Engineering.

Product Lines have most of the functions you would expect to find in a small company. The focal point for profit measurement at DIGITAL is the "Product Line." Product Line Managers are responsible for profits accrued by their market areas. One or more Product Lines within a market segment may be targetted at very specific markets with resident engineering groups established to meet the needs dictated by Product Line market areas.

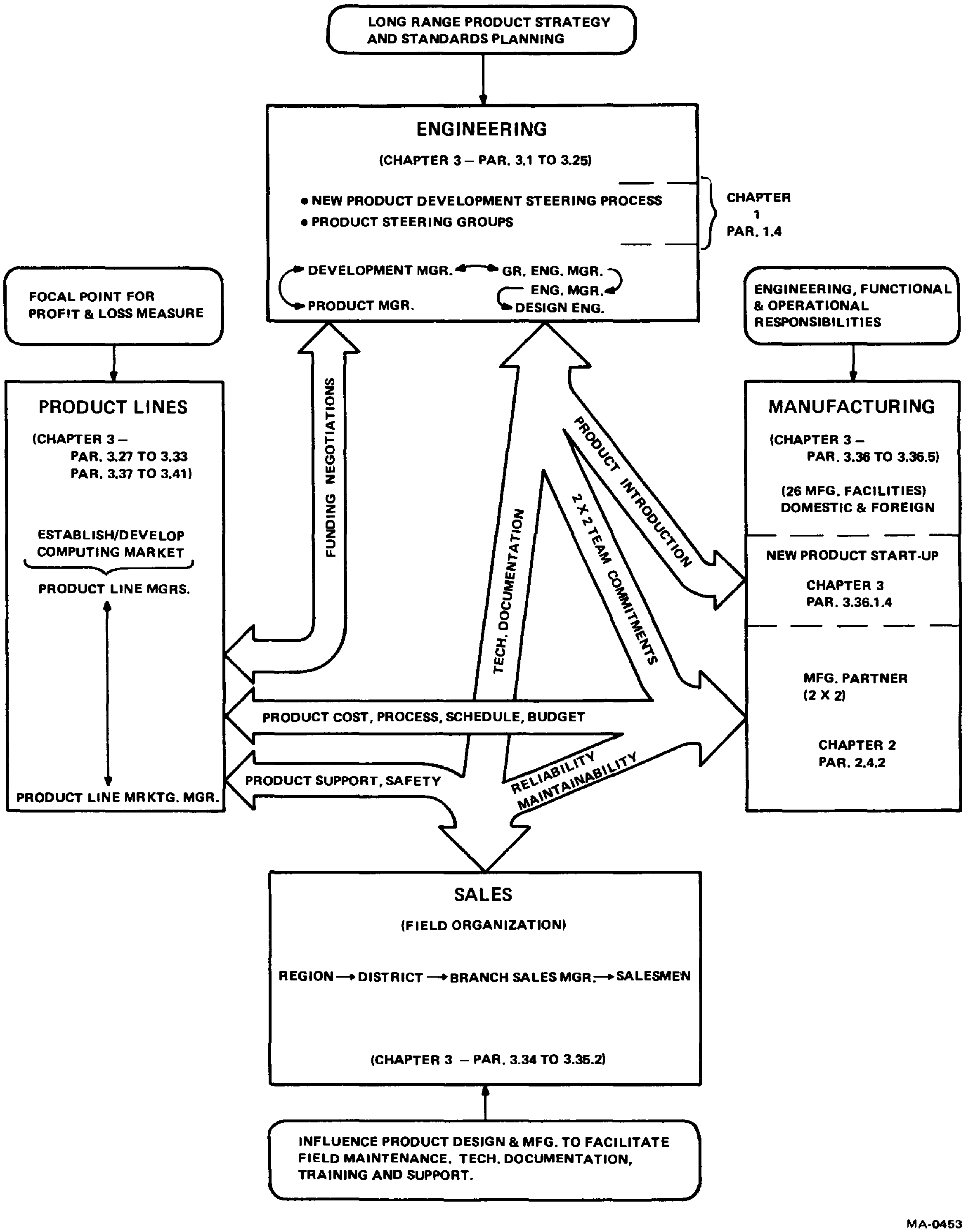


Figure 1-1 DIGITAL Structure

Sales (Field Organization) consists of Sales, Field Service, and Software Support groups within most of the field offices. Sales field offices in North America, Europe, and General International Area locations provide promotional and sales services. Sales training programs are developed by Sales Training groups and made available to the entire sales force.

Field Service Product Support groups develop Field Service maintenance and business plans, hardware documents, training requirements, product safety requirements, reliability and maintainability programs, and evaluation of these functions during new product development. Software Support provides software services to satisfy DIGITAL's software needs in the field in the areas of warranty support, sales support, and consulting services.

Manufacturing's function is to produce DIGITAL's products at the product's specified quality level, at a manufacturing cost which maintains a competitive position in the market, and to a schedule that meets commitments which have been made to our customers. Manufacturing operations include approximately 26 manufacturing facilities. U.S. locations are in New England, the Southwest, and the West Coast. International locations are in Puerto Rico, Canada, the British Isles, Germany, Hong Kong, and Taiwan.

Manufacturing has a matrix management structure. Four line organizations, Systems Manufacturing, High-Volume Manufacturing, CCM (Components, CPUs, and Memories), and External Manufacturing operate via nine manufacturing groups. Plant reporting is within these groups. The functional organizations cross all line organization boundaries. The key functions which reflect manufacturing's activities are: Manufacturing/Engineering, Quality Assurance, Materials, Distribution, Planning, Finance, and Employee Relations.

1.4 NEW DEVELOPMENT STEERING PROCESS

The New Development Steering Process was established to provide better interaction between engineering and marketing planning. The Engineering Board of Directors (EBOD) informs the Marketing Committee (MC), of which Gordon Bell is a member, of current product development investment plans and consequences. The EBOD also decides on and informs the MC of the partitioning of product development investments into "Pots" (see below). EBOD members are appointed by the Marketing Committee.

The membership of each "Pot" is a system team appointed by the EBOD. The role of Pot Chairman and the Strategy Manager in the operation of the system teams is as follows.

Strategy Managers will bring alternative product (mix) strategies forward, get formal approval by the Pot membership for the product development allocation, report progress of the product developments against the plan, and accept final responsibility for the soundness of the strategy.

Pot Chairmen will get alternative product/market strategies tested, drive for clear decisions and statements of selected strategies, make sure that the interactions at the Pot meetings are effective, and that marketing needs are stated and met. The Pot Chairmen will be responsible in this role to the Engineering Board of Directors.

EBOD and Pots Membership

Engineering Board of Directors

Chairman: Andy Knowles
Secretary: Bruce Delagi
Development: Bob Puffer, Dick Clayton, Larry Portner
Product Lines: Ed Kramer, Bill Long, Julius Marcus, John Leng, Jake Jacobs

Real Time and Computation

Chairman: Charlie Spector
Strategy Manager: Bill Heffner
Secretary: Jack Mileski
Staff Support: Steve Mikulski
Development: George Plowman, Bernie LaCroute, Mike Tomasic, Grant Saviers
Product Lines:
John Buckley (DDP/GIS), Larry Wade (OEM), John Mucci (LDP), John Adams (ESG)

Commercial Applications

Chairman: Buzz Brooks
Strategy Manager: Ed Fauvre
Secretary: Bill Picott
Development: Bill Demmer, Bob Peyton
Product Lines:
Glenn Reyer (DDP), Ron Olson (OEM), Ron Sparck (EPG)

Nets and Communications

Chairman: Don Alusic
Strategy Manager: George Plowman
Secretary: Chuck Stein
Development: Vince Bastiani, Al Dziejma, Tom Donovan
Product Lines:
Jerry Cox (IPG), Don Street (LDP), Bob Klein (LCG), Sal Crisafulli (Business)
Other: Dick Pascal (Field)

Terminal/Small Systems

Chairman: Jerry Witmore
Strategy Manager:. Al Dziejma
Secretary: Bob Moss
Development: Ed Corell, George Beason, Steve Teicher
Product Lines:
Joe Meany (OEM), Bill Chalmers (Terminals), Tom Walton (Micro), Mike Gallup (Business), Al Wallack (LDP), Bill Turner (DDP)

Base Systems

Chairman: Art Campbell
Strategy Manager: Dick Clayton
Secretary: Frank Sanjana
Development: Jim Marshall, Bill Demmer, Pete van Roekens, Bill Heffner, Ed Fauvre
Product Lines:
Mike Mensh (TELCO), Bill McBride (LDP), Anders Nordin (IPG), Herb Shanzer (DDP)

Storage Systems

Chairman: Roger Cady
Strategy Manager: Grant Saviers
Secretary: Ken Sills
Development: Bob Peyton, Ron Ham
Product Lines:
Ulf Fagerquist (LCG), Steve Coleman (OEM), Leo Shpiz (BUS), Mike Marshall (IPG), Art Massicott (DCG)
Other: Lon Beaupre (Mfg.), Don Busiek (FS)

The systems teams depend on product specific interaction of the Product Steering Groups (PSGs) which are chaired by the respective Development Manager and/or Product Manager of an engineering area. Membership consists of Buyers (Product Lines), Manufacturing, Diagnostics, Product Managers and Development Managers, as well as managers of other involved engineering areas. Appointment is by the manager of the represented group. The purpose of PSGs is for communication and review of product-related tactics and day-to-day issues with the technology/manufacturing area manager.

Only a partial listing of PSG groups appear at this printing. Additional groups will be included in future updates of this manual. System Teams (Pots) will charter PSGs as they determine a requirement.

PSG	**Chairman**	**Location**	**Ext.**
Disk	Grant Saviers	ML1-3/E58	2357
Tape	Bob Peyton	ML1-3/E63	5118
Small Systems (SW)	Dick Angel	ML12-3/A62	3632
Small Systems	Mike Worster	ML5-3/E12	3531

CHAPTER 2
LIFE OF A PROJECT

2.1 SCOPE

From product inception to steady-state production, a project involves considerable top-down planning that addresses "What to build," "How to build it," and "Who is involved." This chapter presents an overview of the life of a project to help you, the engineer, (1) determine what your responsibilities are, (2) understand how you are involved, and (3) know which groups you will interface with during the process.

2.2 COMMON GOAL

Like other large organizations, DIGITAL has a structure that helps us channel our energies. Our structures are abstractions built upon real people. We let the structures survive only as long as they help us get our job done. These are the important things to remember about our corporate structure.

1. It influences the way we work, but it never takes responsibility for what we do; only people can take responsibility.
2. It is there to help get the job done; it works well for things like policy decisions. When ideas and problems are involved, however, people are encouraged to talk with anyone in the organization who should be informed or who can help. Don't let structure bar the way.
3. We always try to push decisions down to the lowest level where all information is available.

We must all work together toward a common goal, but we should be aware of the needs and perspectives that each of us brings to the job. Bear in mind that marketing is just as important as design and manufacturing. We can build the best product in the world, but unless we tell our customers about it, they won't buy it and the product fails.

2.3 AREA OF RESPONSIBILITY

Your job is to find out what is right, and then do it. DIGITAL's products are used in critical applications where malfunctions can be expensive for our customers, and in some cases can cause injury to people and property. You are the only one who understands your product completely and must focus on decisions that affect these kinds of applications.

One of the most difficult adjustments at DIGITAL is realizing that you may have little authority over many aspects of your product even though you are responsible for all of it. Hence, it is *not* sufficient to do what is right; you must convince other responsible people of what is right. This is in part a check on your ideas. You should begin to wonder about your decisions when you can't convince others who work with you. It also forces clarity in your thinking. Good communication is a very important part of what is right. You must understand how your specifications will be interpreted. You must ensure that sales personnel and customers understand the limits of a product's specifications. Malfunction due to misuse by a customer is an acceptable excuse only if our customer can be made aware of that misuse through clear and accurate communication.

If you bring honesty, integrity, and love to the people with whom you work, you will succeed where others who look upon DIGITAL's method of product development as a silly game, fail. It is up to you.

2.4 LIFE OF A PROJECT

Effective development and support of our products is essential. Remember that a product is more than hardware; it is documentation, marketing, software, manufacturing, and support. It is reliability and it is profitability.

The Product Manager has overall responsibility for a product and direct responsibility for pricing and marketing. You must interface with the Product Manager and the Product Line(s) Support and Development people to coordinate activities in other areas. Ensure that the Product Manager does not overcommit you, yet keep in mind that you owe him the best product that money can buy. You also owe all of the people who work on your product complete cooperation and you owe respect to yourself. If you cannot identify a Product Manager for your product, you are it. The major actions that occur during the life of a project are illustrated in Figure 2-1.

2.4.1 Planning (What to Build)

Many people must work on your product besides those for whom you are responsible. Starting a product involves a lot of planning and requires much iteration and effective communication both vertically and horizontally at all levels of the corporation. The following paragraphs identify the objectives, the people involved, and the tools necessary to ensure that DIGITAL's products are both reliable to the customer and profitable to the corporation.

Objectives

- To identify a problem, a set of problems, or simply the needs of our customers, and propose a solution that will satisfy them and bring profit to the corporation.

- Explore and define the solution (a potential product) by evaluating its technical, financial, and marketing implications.

- Provide enough information to allow the people with the funds to give the go-ahead for further planning. Possible delay in funding does not curtail development; planning continues unless notified to stop.

People and Groups Involved

- Project Engineer } May be the same person
- Product Manager }
- Product Line Manager
- Product Line Marketing
- Software Engineering
- Customers
- Manufacturing 2×2 Partner*

Tools

- Engineering Proposal (essentially a project specification) – (refer to DEC STD 009.)
- Project Plan (Scheduling – refer to DEC STD 008.)
- Product Business Plan (refer to DEC STD 130, Rev B.)
- Manufacturing Support Plan (refer to "Manufacturing New Product Introduction" in Chapter 3).

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*Your Manufacturing 2×2 Partner is identified by your Engineering Manager, Manufacturing Group New Product Manager, or Joe St. Amour, who is Manager of the Manufacturing New Product Introduction Group. Refer to Paragraph 2.4.2 for a description of the 2×2 team and the writeup on "Manufacturing New Product Introduction Group" in Chapter 3 for more information.

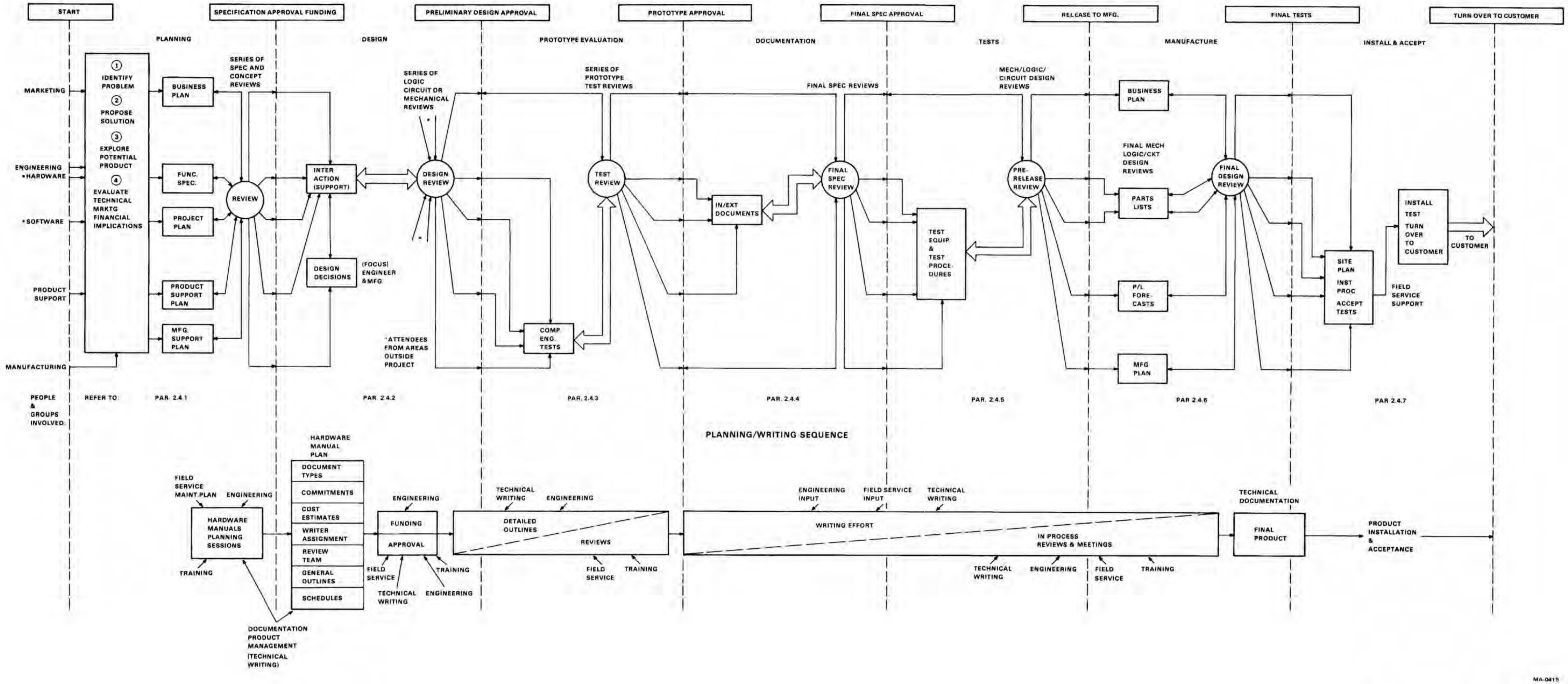

Figure 2-1 Life of a Project
(Sheet 1 of 3)

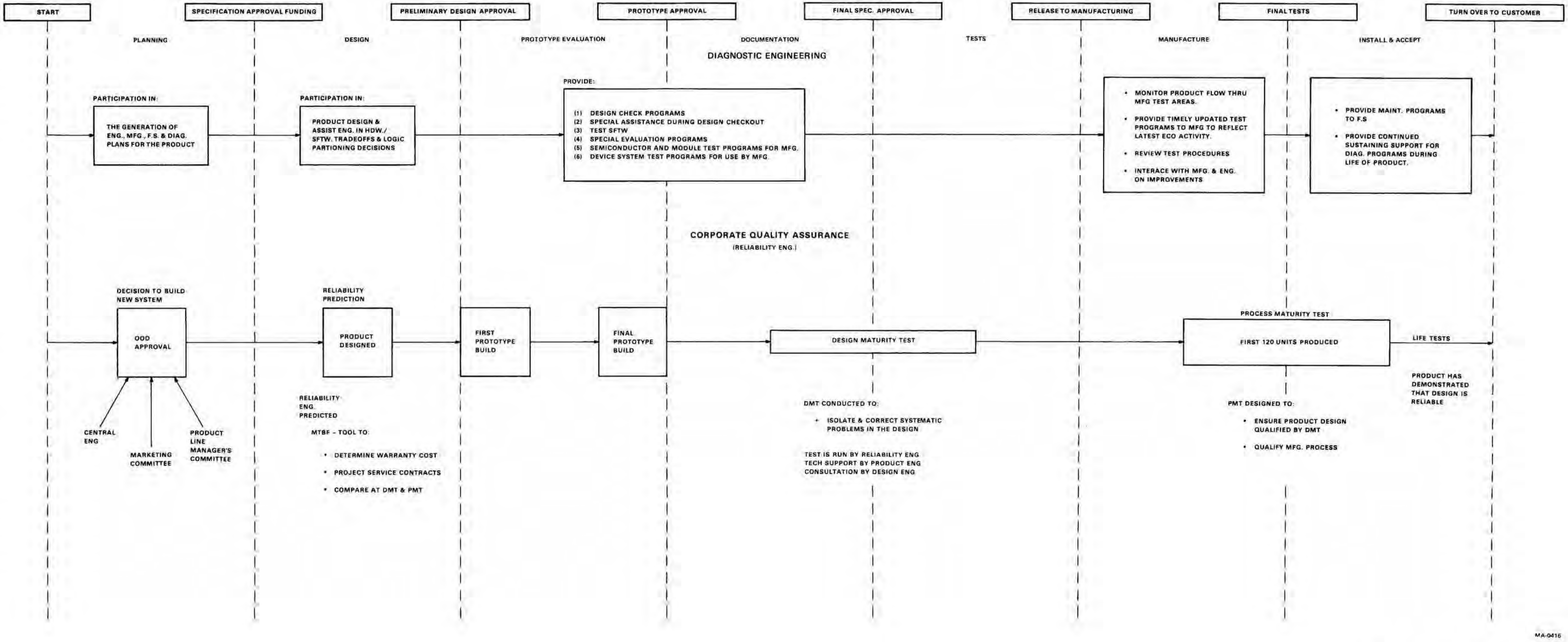

Figure 2-1 Life of a Project
(Sheet 2 of 3)

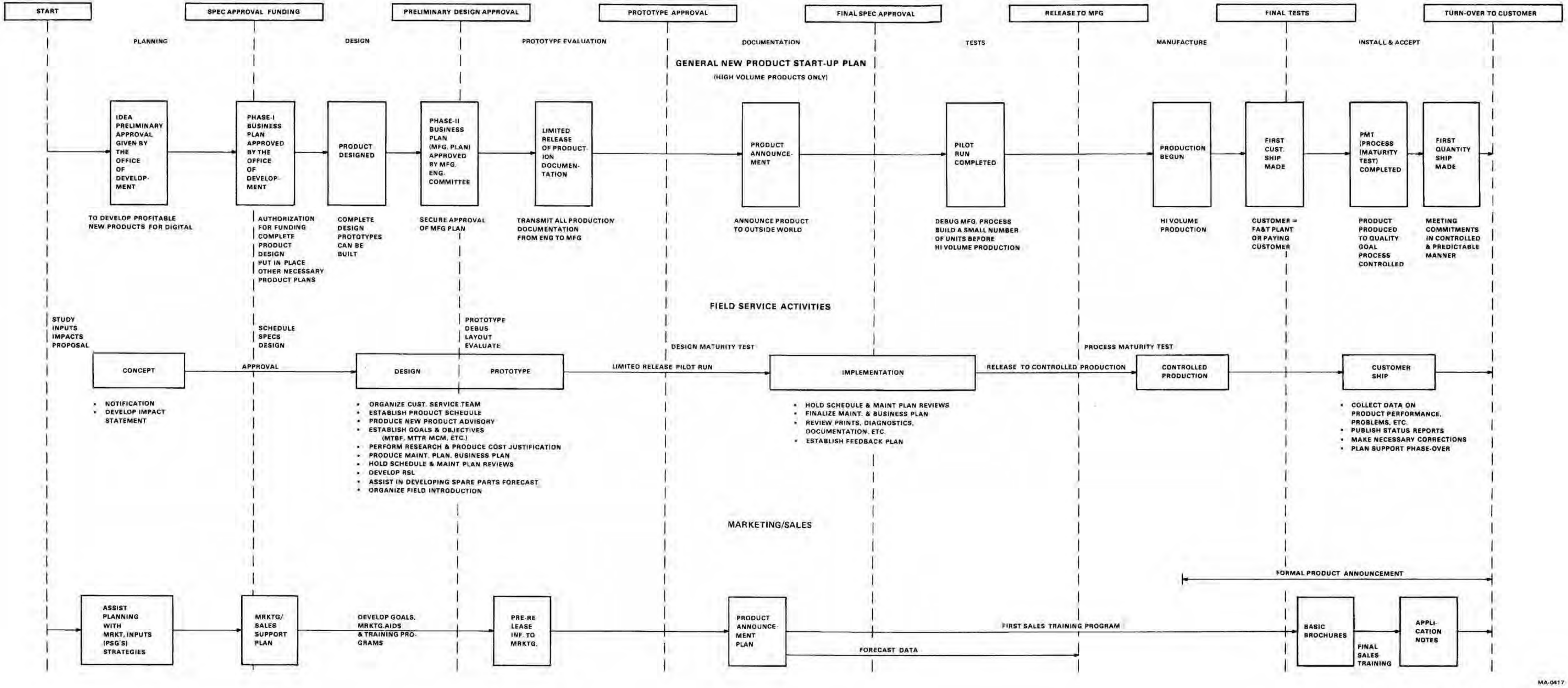

Figure 2-1 Life of a Project
(Sheet 3 of 3)

Engineers may be assigned to a project when the "What to build" phase has been determined. The decision to build a new system is jointly determined by Central Engineering (Office of Development) and the Engineering Board of Directors (EBOD).

Project plans implicitly cover five years into the past for products in support, and about three to five years into the future for products entering the design phase. Major decisions on new products are usually made during formulation of these plans.

It is often difficult to tell when the "What to build" phase ends, but project approval in the form of official funding and a Design Review of the functional specification are two indications that usually mark the end. If you become involved with the project when the functional specification is already written, keep in mind that it may be (1) incomplete, (2) inconsistent, or (3) impossible for reasons you discover during the design phase. In such cases, the specification requires updating with concurrence of at least the Product Manager and the Product Line Marketing Managers where major products are concerned and concurrence of at least two people (remember that the Project Engineer and the Product Manager may be the same person).

NOTE

The Design Review process, types and timing, content and schedules vary according to your project, which may not require all reviews presented in this chapter. Refer to DEC STD 007 for answers to the following questions:

- **Which projects require Design Reviews?**
- **How is a Design Review Committee formed?**
- **When are Design Review sessions held?**
- **What is the output of the Design Review Committee?**

Review
A series of Design Reviews aids the engineer in conceiving and developing the project in a logical and practical manner. Before going into the design phase, a *Specification and Concept Review* should be held to assure that the specification:

1. Completely describes the equipment to be designed, including interfaces (physical and electrical) and a functional relationship between inputs and outputs;

2. Demonstrates the planned implementation of the design (block diagrams, flow diagrams, analysis, specifications for sub units, etc.);

3. Includes tentative mechanical, packaging, test and maintenance, thermal and power requirements, and concepts.

The reason for spending time in getting everyone to approve a project is to allow the business and support managers to implement their plans with confidence that they are working on the same product you are.

2.4.2 Design (How to Build it)
A two-by-two method of product development is used at DIGITAL. Every project is managed by a two-person team; one from Engineering and one from Manufacturing. They are the focus for design decisions and are jointly responsible for introducing the product into Manufacturing.

Engineering responsibilities include:

- Planning, Design, Testing, Documentation
- Startup (jointly with Manufacturing)
- Support of production and Field Service
- Meeting cost goals
- Shipping on schedule.

Manufacturing responsibilities include:

- Product Introduction Plan
- Influence design to ensure manufacturability
- Capacity forecasting
- Volume production - documentation and successful implementation.

It is highly important for you to identify with your Manufacturing Partner. Refer to the "Manufacturing New Product Introduction" writeup in Chapter 3 for direction to the "right people" to contact.

The rest of the people within the groups listed have developed special expertise in their own areas. The interaction between you and the various groups and the assistance they offer is discussed in detail in Chapter 3.

Objectives

- Design a product that is programmable.
- Design a product the customer can use.
- Translate the functional requirements into a design that Manufacturing can use to build.
- Provide a design that is serviceable by Field Representatives.
- Provide enough detail to allow support groups which include:
  Drafting,
  Technical Documentation,
  Test Personnel, and
  Programmers,
  to do their jobs.

People and Groups Involved

- Design Engineer
- Manufacturing 2X2 Partner

} Design Decisions

- Software Engineering
  Help to define software interface,
  Create drivers and define intelligent tests and standards.

- Component Engineering
  Help research and specify component needs.

- Purchasing
  Help with vendor selection, sourcing and problem solving.

- Design Drafting
  Provides manual and automatic design drafting assistance; information about DEC Standards, documentation, and corporate guidelines. Watches spending and acts as a communication link for all Engineering services.

- Diagnostic Engineering
  Assist in hardware/software tradeoffs and logic partitioning decisions; generates diagnostics for your product.

- Model Shop
  Supplies fabrication in metal, plastic, wood, clay, and foam. Assembles prototype modules, small subassemblies, and cable harnesses. Provides PC board modules, hand testers, odd jobs, and quality testing. Provides low volume blasting of PROMs.

- Technical Documentation
  Provides documentation planning, technical writing services, publication services, printing and distribution services.

- Mechanical Engineering
  Packaging design, materials evaluation, connector tests, heat transfer/flow, casting and molded parts design.

- Industrial Engineering
  Industrial design, appearance, and product design concepts (panels, colors, etc.).

- Field Service Product Support
  Help design in supportability features and plan for field support. The Support Plan introduces your product to all Field Service offices.

- Reliability Engineering
  Provides early mean time between failure predictions.

- Appropriate Process Engineering Group
  Advanced Process Engineering
  CPU Process Engineering
  Terminals Process Engineering
  Disk/Tape Process Engineering
  Cross Products Process Engineering
    Consult with the engineer on our way of manufacturing/testing and the manufacturability/testability of the product. When necessary, they can design jigs and tools to facilitate manufacture.

Even though you may not need the services of all the above groups, you should know how they can help and at what stage of product development you should seek their help.

Tools

- Functional Specification (DEC STD 009)
- Engineering Project Plan (DEC STD 009)
- Manufacturing Plan (Mfg. 2X2 Partner)
- Other applicable DEC Standards
  A listing of DEC Standards, revision and titles is available from Engineering Information Services and Distribution Services (location and extension provided in the DEC Telephone Directory).

Review
A logic, circuit, and/or mechanical Design Review should be held prior to ending this phase. People from outside the project attend these reviews and help you find problems and offer their advice.

Preliminary Logic Design Review
This should be held as soon as possible after completion of the design and prior to generation of board layout. The data should include the logic diagrams, some form of specification, preliminary map of the locations of chips and pins, timing diagrams of critical paths, etc.

Preliminary Circuit Design Review
(Not applicable to "pure" logic using purchased chips.) This review should be held as soon as the circuit is designed and the supporting analysis and critical portions have been breadboarded, and prior to the generation of artwork and detailed packaging. The data available should include the schematic, parts lists, stress calculation, stability analysis, power requirements, MTBF estimates, and supporting test data.

Preliminary Mechanical Design Review
This should be held prior to generating a complete set of drawings so that the inputs from Manufacturing, Field Service, and other attendees can be considered. You should show sufficient detail in the project specification or a separate mechanical specification to assure that the design will meet all requirements. You may include sketches, models, mock-ups, and/or assembly type drawings, analysis, and calculations to show thermal and structural integrity.

2.4.3 Prototype Evaluation
To build a prototype, you will probably need the services of the Model Shop. They have the facilities to assemble prototype modules, small subassemblies, wire-wrap, cable harnesses, etc. (see Chapter 3).

Objectives

- To shake the bugs out of your design.
- To document what your product can and cannot do.

People and Groups Involved

- Engineering
- Component Engineering
- Model Shop
- Diagnostics
- Environmental Testing
- Reliability

Tools

- DEC Standard 102 and other DEC Standards relating to your needs (refer to Paragraph 2.4.2, Tools).

DEC has test chambers for environmental testing for heat, humidity, and supply voltage and frequency. These factors can be isolated or coupled. Outside testing facilities are used for additional testing as required.

Your test strategy depends on the intended market, the intended manufacturing process, and the product itself. Component Engineering, responsible Process Engineering Group (CPU, Disk/Tapes, Terminals, Cross Products) and Reliability can help with a test strategy. Reliability can also help in statistical analysis.

You will need diagnostics to help test your product. Ensure that Diagnostic Engineering's schedules mesh with your own.

When you are satisfied with your design, Reliability Engineering will evaluate engineering prototypes and/or initial manufacturing pilot units. The Environmental Testing Group and Acton Labs will do the testing required by DEC Standard 102. Refer to this standard for more information.

Review
A *Prototype Test Review* is held to examine the results of prototype testing and conclusions drawn from the test data. This information should be presented to the reviewers and planned corrective action should be discussed in great detail. This review is held *only if* prototype evaluation has changed the specification.

2.4.4 Product Documentation

You must provide all the information necessary to allow in-house people to develop all of the documentation required to build, sell, support, and maintain your product.

Objectives

- To describe clearly, accurately, and completely the product you plan to build.
- To ensure adequate documentation is made available to all users and maintainers.

People and Groups Involved

- Creators

Design Engineers and Technicians Design Drafting PC Layout (manual and automated)	Internal Documentation
Design Engineers and Technicians Training Technical Documentation	User Documentation

- Users
  - Manufacturing
  - Field Service
  - Training
  - Customers
  - Software Engineering
  - Field Service Depot Repair

- Maintainers
  - ECO Control (Internal Documentation)
  - Technical Documentation (User Documentation)

Tools

- Functional Specification
- Field Service Philosophy
- Applicable DEC Standards

Internal documentation is required to allow Manufacturing to make your product, Field Service to service it, and ECO Control to implement corrective action when changes are required. User documentation allows our customers to get the best use from our products.

You should contact the Technical Documentation group and your satellite supervisor when you are setting up your schedule. They can help you with your schedule and with your budget.

In general, the more information you put into your specifications, drawings, and product descriptions, the faster and better the documentation job. In the technical documentation area especially, the biggest problem is access to good information. Try to make yourself available to answer questions. Shortcuts, skimpy information, and sloppy drawings greatly degrade the documentation.

Good documentation allows our Field Service people to save money. Even more important, it makes our people more efficient. This is especially important since the supply of qualified people is limited. You will obtain a significant cost savings for your product by making sure you get the best documentation possible.

PC layout can be manual or automated. The manual job takes 10 to 13 weeks; the automated job takes less. For boards made to DEC Standard 030, with fewer than 100 ICs, automated PC layout takes 6 to 8 weeks, and there is no need for an extra week for GEMS* digitizing.

Review
A *Final Specification Design Review* is held to assure that the specification is correct, complete, and acceptable. The data supplied to the reviewers is a complete specification.

Once you authorize limited release of your product specifications, your drawings go under ECO (Engineering Change Order) control, and you must sign off any changes made after that. DEC Standard 100 describes the ECO process. Make sure that the Training Department is aware of your product and is scheduled to give courses at the appropriate time. They can give you feedback on how much documentation is necessary. Anything you don't supply that they need, they will have to write themselves – at a greater expense (because they often have less information to work with) and with less general usefulness, because training materials do not get the same kind of distribution that standard user manuals get.

2.4.5 Requirements For Testing
Equipment for testing, procedures for manufacturing, and field fault analysis must be ensured for testing prototypes and first manufacturing builds.

Objective

- To make sure that proper manufacturing testing equipment and procedures are available.
- To make sure that proper testing equipment and procedures are available for installation and service.
- In both cases, balancing cost of manufacturing, or servicing the product against the cost of testers and test programs.

People and Groups Involved

- Engineering
- Manufacturing 2X2 Partner
- Test Strategist
  A representative from the responsible Process Engineering Group (CPU, Disk/Tapes, Terminals, Cross Products) Refer to "Process Engineering" writeup in Chapter 3 for proper contact.
- Reliability
- Environmental Test
- Diagnostic Engineering
- Model Shop
- Field Service Product Support

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*GEMS is described in Chapter 3, Design Drafting.

Tools

- Test Strategy
- Business Plan (for projected volume)
- Manufacturing Plan

The people involved should combine their technical know-how in developing the manufacturing and field test strategy.

The Model Shop will provide testers for small quantity requirements; the responsible Process Engineering group will take care of volume production of testers. Testers and module jigs are handled through Test Equipment Manufacturing (Process Engineering group in Acton).

Review
Pre-release mechanical, logic, and/or circuit Design Reviews are held as necessary to examine the details of changes in testing found desirable or required in prototype build and evaluation, prior to limited release for pilot production. The reviews may be combined if the changes are minor.

2.4.6 Manufacturing
You must introduce your product to Manufacturing. It is of utmost importance that the Manufacturing facility that will build your product and your partner in the 2×2 team effort be identified early in the life of your project. Refer to the "Manufacturing New Product Introduction" writeup in Chapter 3 for direction.

Objective

- To translate your design into a product our customers can use.

People and Groups Involved

- Engineer
- Manufacturing 2×2 Partner
- Drafting
- Field Service
- Marketing (Product Lines)
- Relevant Plant's Materials Manager
- Purchasing
- Component Engineering
- Purchase Specifications
- Advanced Process Engineering
- Responsible Process Engineering group (CPU, Disk/Tapes, Terminals, Cross Products)
- Diagnostics

Tools

- Business Plan (DEC STD 130)
- Manufacturing Plan (Manufacturing's New Product Manager)
- Parts List and Purchase Specifications (refer to "Component Engineering" in Chapter 3)
- Product Line Forecast (Rainbow Books, Chapter 4)

The following items are necessary for introducing a product to Manufacturing:

- Complete Documentation Complete parts list, including part descriptions for all assembly levels of the product.
  - Parts List — Engineering Responsibility
  - Part Description — Engineering Services Responsibility
  - Manufacturing print set for all modules and testers - provided via Engineering Services
- Training for technicians (Manufacturing Training Courses)
- On-site support (Diagnostic Engineering)
- Diagnostics and tester software. (Major systems use so-called ACT testers - Automated Computer Testing). Software for such systems must be budgeted separately. Automated Product Test (APT)
- Models if required (Model Shop)
- Templates for insertion, or tapes (Engineering Design Services)
- Multi-sourcing for new components
- Incoming inspection procedures and test equipment } (Component Engineering)
- Testing procedures and equipment

If you're using new or unusual parts, or require a large volume of parts, be sure to allow enough time for the facility to stock them. Purchasing can help you with this kind of information. Some Manufacturing facilities perform a "burn-in" for each new product (Process Maturity Test, PMT) to evaluate whether the Manufacturing process is a mature one capable of producing products at the desired quality.

Review
Final mechanical, logic and/or circuit Design Reviews are held to examine the problems and corrective actions found desirable during pilot run (first physical product builds) prior to release to full production.

2.4.7 Installation and Acceptance

Installation procedures and customer acceptance tests should be available to the Field Service Support people to install and test the product (system).

Objective

- Install and test system on site.

People and Groups Involved

- Site Planning
- Design Engineer
- Field Service Support
- Marketing (Product Lines)

Tools

- Installation Procedures } Hardware Manual
- Acceptance Tests

The Engineer, Field Service Product Support representative, and the Marketing Manager, with the help of the systems programmers, diagnostic programmers, and Software Support people should have combined their efforts in supplying the proper installation procedures to the Technical Documentation group in time to publish that information prior to the product delivery date. When the product is operating properly after installation and test, it is turned over to the customer.

CHAPTER 3
GROUP RELATIONSHIPS

This chapter contains a brief description of Hardware and Software Engineering, Manufacturing, Product Lines, Service Groups, and other related group functions and responsibilities. The information presented herein provides you with an effective guide in determining what is happening, who is responsible, and when and how to establish a good relationship with the people you may have to interface with in the performance of your job.

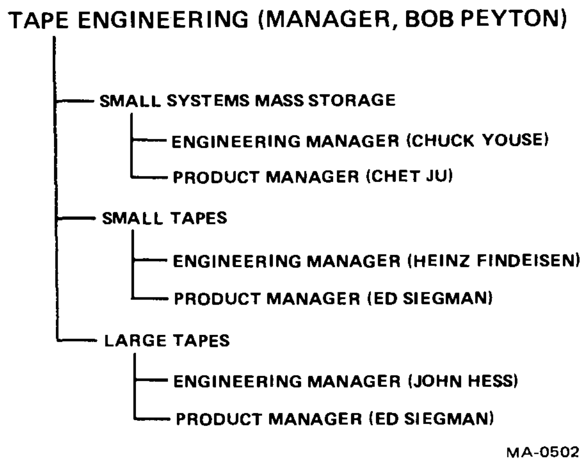
We have worked with individuals from each represented group in this chapter with sincere intentions to develop a coherent, clear, and concise presentation of the many organizations within DIGITAL.

We realize that the descriptions of the diversified and complex groups and your relationship with the people within these groups require refinement in content and format. We hope to accomplish this in future printings since we expect to update this manual on a quarterly basis.

However, we hope that we have succeeded in providing you with meaningful information *NOW*. We welcome your comments and suggestions for improvement via the Reader's Comments form provided on the last page of this manual.

3.1 TAPE ENGINEERING

Tape Engineering plans and develops floppy disks and low, medium, and high performance tape products. They solicit the appropriate Product Lines to determine user requirements identified by their market areas. The group structure and the responsible people who should be contacted are given below.



When Should Tape Engineering be Contacted?
Primarily, Product Lines or anyone within DEC who has problems or good ideas with respect to tape products should contact the responsible person(s) as early as possible during the planning and design concept stages of their product.

What Tape Engineering Can Supply

- Resource to the company in magnetic coated flexible media and equipment technology in all forms; floppies, half-inch tape, tape cartridges, cassettes, and their successors.
- Identify and develop successor technology where applicable.
- Define and develop tape products (and successor technology products) that are broadly applicable and responsive to market needs as identified by the Product Lines.
- Define and develop tape products that are specific and narrow in scope but strategic in function.
- Oxide-coated mylar technology.

What Tape Engineering Needs to Accomplish Their Goals

- Product Plans
- Description of needs

3.2 DISK PRODUCTS

The Disk Products group is responsible for designing rotating mass storage devices or disk subsystems for DIGITAL. Disk Development groups are responsible for designing disk products from the component level design up to subassemblies and the total product development. They are also responsible for releasing their designs to Manufacturing and maintaining their products in the field during early customer ships.

DISK PRODUCTS (MANAGER, GRANT SAVIERS)

- DISK ENGINEERING
  TECHNICAL DESCRIPTION, DESIGN AND RELEASE TO MANUFACTURING OF ROTATING MASS STORAGE DEVICES
- PRODUCT PLANNING
  RESPONSIBLE FOR DISK PRODUCT STRATEGY FOR THE FUTURE
- PRODUCT MANAGEMENT
  RESPONSIBLE FOR ALL BUSINESS ASPECTS OF DISK PRODUCTS; INTERFACE WITH MARKETING AND THE PRODUCT LINES.
  MAJOR DISK DEVELOPMENT PROJECTS HAVE AN ASSOCIATED PRODUCT MANAGER
- ADVANCED PRODUCT DEVELOPMENT
  NEW IDEAS RELATED TO DISK PRODUCT TECHNOLOGY. RESPONSIBLE FOR BRINGING NEW IDEAS TO THE BREADBOARD STAGE AND DEMONSTRATE FEASIBILITY.
- SUBSYSTEMS
  RESPONSIBLE FOR CONTROLLER FUNCTIONAL SPECIFICATIONS, HARDWARE DESIGN AND RELEASE TO MANUFACTURING.
  PROVIDE NECESSARY DOCUMENTATION ASSOCIATED WITH THE SUBSYSTEM.

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(Group Managers will be identified in the next printing.)

When Should Disk Products be Contacted?

Whenever an engineer, a Product Manager, a Product Line representative, or anyone within DIGITAL has the need for the expertise that the people within the Disk Products group can provide.

What Disk Products Can Supply

- Business and technical advice on specialized selection of disk products
- Expertise in design of rotating mass storage devices or disks
- Acquisition of disk products from outside vendors
- Linear voice coil actuators and servos
- Read/write electronics technology
- Magnetic recording technology
- Disk subsystem concepts

What Disk Products Needs to Accomplish Their Goals

- Business Plans
- Description of needs

3.3 RESEARCH AND DEVELOPMENT (R&D)

The Research and Development group provides research, advanced development, information services, consulting, technical education, and technical staff services to the corporation, with particular emphasis on meeting the needs of Central Engineering.

When Should You Contact R&D?

Whenever you have a need for their services; contacts are identified in the following descriptions of their areas of expertise.

What R&D Can Supply to You

- Research – conducting an internal research program and interfacing with external researchers.

  This is R&D's largest activity. "R&D Group Strategy," "R&D Group Plan for Current Fiscal Year," and "R&D Project Procedures" are documents that contain information on what they are doing and how they are doing it and are available to you on request.

  They are anxious to consider suggestions from all within the company – let them hear from you.

  The group writes a monthly report which includes project status reports on every active research project. This is also available to you on request. Every project has a plan, and periodic technical reports are issued. Most projects have special interest lists for those who would like to receive memos and other more detailed material on the topic. However, the best way to learn more about a specific project is to contact the Project Leader directly.

- Advanced Development activity complements both their own research and the Advanced Development activities that are distributed among many other engineering groups.

- Information Services – provided by the Corporate Library (detailed description provided in another section of this chapter).

- Consulting – providing consulting on a wide variety of technical subjects, utilizing both internal and external resources. (Contact Rollins Turner, Ext: 3938.)

- Technical Education – supplying, influencing, and coordinating technical education activities within Central Engineering.

  They are willing to provide technical speakers from their group on a broad range of subjects, including their current research projects. For a list of topics and speakers, contact Dee Johnson, Ext: 7687.

  The group also coordinates a monthly Engineering Seminar. Contact George Poonen, Ext: 3537 for more information.

- Technical Staff Services – providing other technical staff functions as designated by the Vice President of Engineering, with emphasis on those services which are future oriented, are leveraged by a broad payoff, or serve to bind together the activities of diverse groups.

  An example of this kind of activity is the semi-annual publication "The Research and Advanced Development Beige Book," which draws together in one document the descriptions of such activites throughout the corporation.

What R&D Needs From You

- Contact the person listed in the areas above or the R&D Group Manager, Jim Bell, Ext. 7687 for information.

3.4 PDP-11 SYSTEMS ENGINEERING

Systems Engineering performs a wide range of hardware development and support activities as detailed below.

SYSTEMS ENGINEERING (MANAGER, PETER VAN ROEKENS)

- MECHANICAL ENGINEERING (DICK GONZALES)
- SYSTEM PERFORMANCE EVALUATION (RALPH PLATZ, ACTING)
- SYSTEMS INTEGRATION (DICK TESTA)
- SYSTEMS ARCHITECTURE (RALPH PLATZ)
- SYSTEMS INTERCONNECT ENGINEERING (HOWARD FINEMAN)
- ADVANCED DEVELOPMENT/SPECIAL PROJECTS (PETER JESSEL)

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Mechanical Engineering
Provides mechancial engineering in the development of -11 family packaging as well as providing follow-up support.

System Performance Evaluation
Develops tools for use in measurement of the -11 family computer performance. Assists other groups in their system performance evaluations.

Systems Integration
Develops tools for -11 system configuration. Provides system product evaluations. Performs system support activities in support of system manufacturing plants. Working development of system RAMP (Reliability and Maintainability Program) goals.

Systems Architecture
Specifies and maintains global architecture definitions/specifications/standards for -11 family of products.

Systems Interconnect Engineering
Develops new I/O bus structures and supports electrical interface integrity through -11 family and cross-family bus standards (e.g., Massbus).

Advanced Development/Special Projects
Develops special systems projects. Currently involved with -11 multiprocessor development.

When Should Systems Engineering be Contacted?
Initial descriptions and preliminary project plans should be sent to Peter van Roekens at ML12-2/E71 as soon as available. They will then take the initiative to follow up as required.

What Systems Engineering Can Supply

- Mechanical Engineering provides the assurance that -11 products meet specifications for heat dissipation, noise level, vibration, and cabling requirements. It also supplies mechanical system design input and support to Marketing and Field Service to ensure viability of the system in the field environment.

- System Performance Evaluation supplies services and systems information on both DIGITAL and competitive products. Offers assistance to other groups in running their analyses and in subsequent interpretation of the results.

- Systems Integration provides assurance of dock-mergeable products. Configuration systems support is supplied to manufacturing. In addition, Systems Integration offers an understanding of and involvement in RAMP efforts at the conceptual level.

- Systems Architecture provides long-term architecture strategy and identification of problems, issues, opportunities, and risks. Assists in architecture specifications and maintains global -11 specs.

- Systems Interconnect supports cross -11 interface options and helps solve related manufacturing and integration problems. It provides consulting, guidance, and tools to assure bus compatibility and signal integrity throughout the -11 family. It offers higher performance and lower cost systems by developing new bus structures. Systems Interconnect is also responsible for Massbus, Serial bus, etc.

- Advanced Development/Special Projects currently are developing approaches to -11 multiprocessing and high availability. Offers expertise in the design of high volume standard systems.

What Systems Engineering Needs From You to Accomplish its Goals
Involve them. They have broad based expertise that can help you.

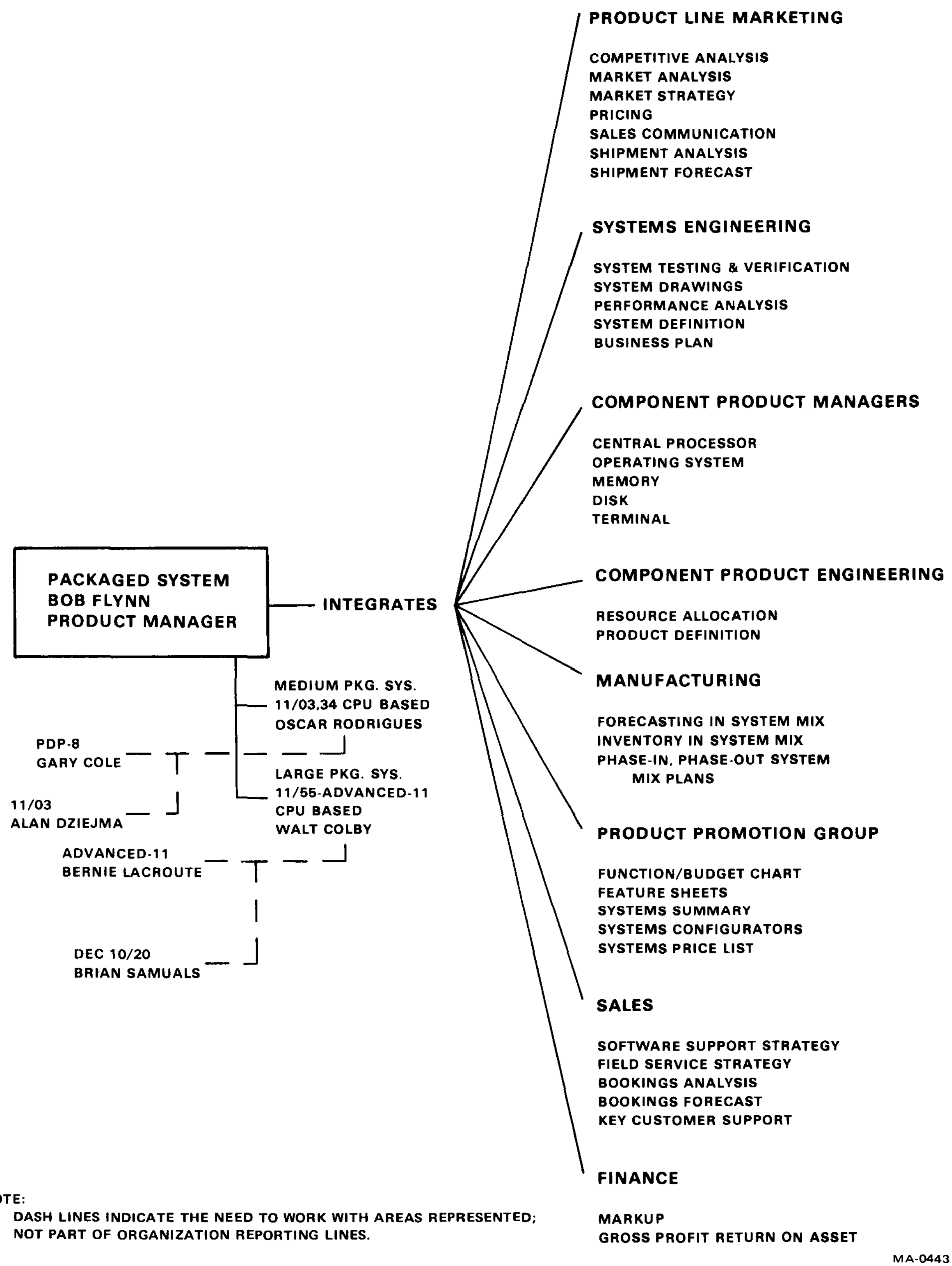
3.5 UNIBUS-11 ENGINEERING

The Unibus-11 Engineering group is responsible for the development and support of all Unibus-11 processors, 11/04 through 11/70. The group is composed of two development teams which split the overall group's responsibility by size. The Large-11 team (Contact: Jim Marshall, Acting) is responsible for the 11/45 through 11/70, and the Small -11 team (Contact: John Sofio) covers the 11/04 through 11/40. The Advanced Technology team (Contact: Nathan Parke) is responsible for providing an advanced development capability for new processor developments and for specifying enhancements to existing products. They also serve as technology gatekeepers and as a source of micro-programmers for the development teams.

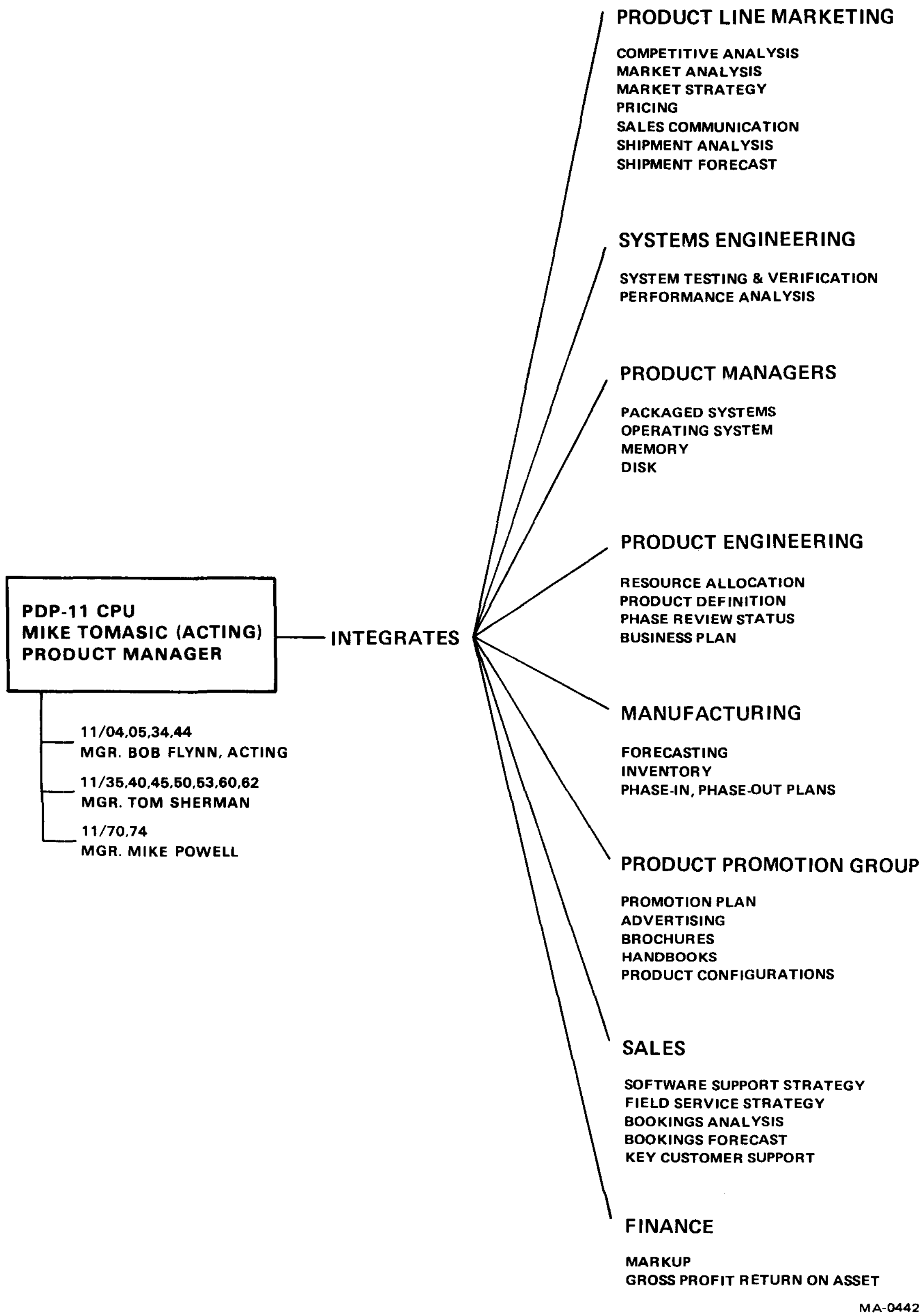
When Should You Contact Unibus-11 Engineering?
Those persons desiring information on Unibus-11 existing designs and/or new products should contact the respective Team Manager.

3.6 SYSTEM/PRODUCT MANAGEMENT UNIBUS-11

System/Product Management performs product management functions in the PDP-11 CPU and Packaged System Product areas. The Product Management role includes responsibility for all traditional functional business areas, including Engineering, Manufacturing, Marketing, Sales, and Finance whenever appropriate from an integration of DIGITAL's business and from a product viewpoint. The following diagrams list some areas of appropriate product manager responsibilities.



NOTE:
DASH LINES INDICATE THE NEED TO WORK WITH AREAS REPRESENTED; NOT PART OF ORGANIZATION REPORTING LINES.


PDP-11 CPU
MIKE TOMASIC (ACTING)
PRODUCT MANAGER
11/04,05,34,44
MGR. BOB FLYNN, ACTING
11/35,40,45,50,53,60,62
MGR. TOM SHERMAN
11/70,74
MGR. MIKE POWELL
INTEGRATES
PRODUCT LINE MARKETING
COMPETITIVE ANALYSIS
MARKET ANALYSIS
MARKET STRATEGY
PRICING
SALES COMMUNICATION
SHIPMENT ANALYSIS
SHIPMENT FORECAST
SYSTEMS ENGINEERING
SYSTEM TESTING & VERIFICATION
PERFORMANCE ANALYSIS
PRODUCT MANAGERS
PACKAGED SYSTEMS
OPERATING SYSTEM
MEMORY
DISK
PRODUCT ENGINEERING
RESOURCE ALLOCATION
PRODUCT DEFINITION
PHASE REVIEW STATUS
BUSINESS PLAN
MANUFACTURING
FORECASTING
INVENTORY
PHASE-IN, PHASE-OUT PLANS
PRODUCT PROMOTION GROUP
PROMOTION PLAN
ADVERTISING
BROCHURES
HANDBOOKS
PRODUCT CONFIGURATIONS
SALES
SOFTWARE SUPPORT STRATEGY
FIELD SERVICE STRATEGY
BOOKINGS ANALYSIS
BOOKINGS FORECAST
KEY CUSTOMER SUPPORT
FINANCE
MARKUP
GROSS PROFIT RETURN ON ASSET
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When Should Product Management be Contacted?
Whenever appropriate from a product viewpoint.

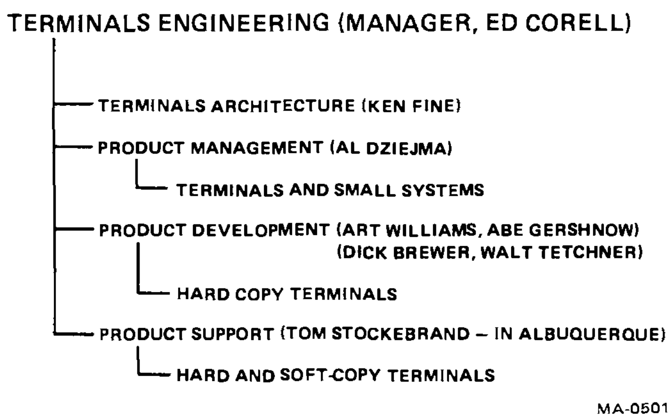
Contacts: Group Manager, Mike Tomasic
Corporate Packaged Systems, Manager – Bob Flynn
Unibus-11 CPU Product Management, Manager – Mike Tomasic, (Acting)

What Product Management Can Supply
Whatever is reasonable from a product integration viewpoint.

What Product Management Needs to Accomplish Their Goals
Open two-way communication and support from all functions of DIGITAL whenever appropriate from a product integration viewpoint.

3.7 TERMINALS ENGINEERING

Terminals Engineering designs video display and printer terminals and some I/O devices. The group works closely with Manufacturing and Marketing and is highly cost-sensitive. The functional structure and the responsible people are given below.



When Should Terminals Engineering be Contacted?
Very early, possibly during the planning and design concept stages.

What Terminals Engineering Can Supply

- Advice on specialized selection of products
- Expertise in modification of a terminal
- Acquisition of terminals from outside suppliers, e.g., line printers and card readers.

What Terminals Engineering Needs to Accomplish Their Goals

- Product Plans
- Description of needs

3.8 SMALL SYSTEMS ENGINEERING

Small Systems Engineering plays an integral role in DIGITAL's low end, LSI-11 specific business. The low end includes Intelligent Single Station Terminals, Intelligent Clustered Terminals, Small Standalone Systems and Components (boards, chips, peripherals). The low end business is currently defined as those products having a customer cost from approximately $1,000 to $15,000. This market segment was created through evolutionary shrinking of hardware sizes and prices, while maintaining the functionality of earlier systems.

Small Systems Engineering works closely with Software Engineering, Diagnostics, Documentation, Product Support, the Product Lines, and other groups inside DIGITAL to create a coherent low end offering. They are experimenting with modular packaging systems and such areas as drop-shipping system components to customers.

Small Systems Engineering Group Managers and related functions are given below.

PDP-8, Manager: Stu Klein

This group is funded by the PDP-8 Product Line and provides:

- Engineering support for all Omnibus and Micro-8 products.
- Development of new PDP-8 products
- Engineering support to other Product Lines developing PDP-8 based products
- Information, consultation, and support to anyone within the company who has an interest in PDP-8 related products
- Development of microprocessor based PDP-8 related products

When Should You Contact the PDP-8 Group?

Contact this group when you require information, consultation, and support in related PDP-8 areas.

Current LSI-11, Options and Support, Manager: Craig James

This group performs product support and standard and advanced product development functions.

- Support is provided via: (1) the Project Engineering Lab which is available for solving field and customer problems and testing; (2) LSI-11 Bus application control, and; (3) front-end design standardization.

- Standard product development of LSI-11 Bus options and standard systems which are of a cross-product nature or have sufficient Product Line volume to support Central Engineering Development.

  Responsibilities include controlling (and exporting) basic LSI-11 chip set design and application information to in-house design groups.

- Advanced projects include system development and custom LSI development of both CPUs and special function controllers.

When Should You Contact Current LSI-11, Options and Support Group?

This group should be contacted when you require help in LSI-11 related areas. This group can provide consultation on the use of test equipment available in the Project Engineering Lab. You may realize a need for this service during the breadboard stage of your product.

Interactive Terminals and Systems Group, Manager: Len Halio
This group provides:

- Standard high volume small systems packaging
- Leadership in video terminal/small systems architecture
- Dock mergeability and customer installability on a wide variety of video terminal/small system products
- Model systems built to above concepts
- Highly interactive man-machine interface environment on small systems

When Should You Contact Interactive Terminals and Systems Groups?

- During the product concept stage
- Whenever you need information with respect to related small systems power supplies
- When building or modifying a terminal
- For consultation on architectural techniques.

3.9 ADVANCED-11 COMPUTER CHIPS ENGINEERING, Manager: George Beason

The Advanced-11 Computer Chips group is chartered to manage the identification, specification, and development of state-of-the-art systems components and micro-circuit families to support low end systems products.

When Should You Contact Advanced-11 Computer Chips Engineering?
Whenever you need relevant processor types as the primary engine for your product.

What Advanced-11 Computer Chips Group Can Supply to You

- Technology and managerial expertise to drive advanced processes into DIGITAL fabrication facilities, assuring competitive performance and cost effective microcircuits.

- Support marketing evaluation of the opportunities and plans to sell chip level components.

- Technological link to the advances in process semiconductor architecture and circuits.

3.10 OPTION LISTS, DESIGN REVIEWS

Option Lists and Design Reviews are integral functions generated and maintained via the Office of Chief Engineer. The individual responsibilities and how they relate to you are described in the following paragraphs.

Responsibilities of the Chief Engineer, Dick Best

- Assigns option, model, and module numbers. Maintains listing and enters it into the Engineering Product Library System (EPLS).

- Approves Engineering Services Work Requests.

- Approves nomenclature on Master Price List Maintenance Form.

- Publishes:
  Engineering Newsletter (monthly)
  Option, Model, and Module List (monthly).

- Provides Technical and Engineering Systems consulting.

- Member of:
  Engineering Review Board
  Engineering Committee
  Patent Committee.

Responsibilities of Carl Noelcke

- Administers Design Reviews:
  Each product development project that has been assigned a Discrete Project Number and has a well defined completion point is subject to the Design Review process.

- Receives Design Review plans from Project Engineer and arranges to have Project Engineer present plan to Engineering Committee for approval.

- Secretary of Engineering Committee:
  Arranges agenda
  Writes and distributes minutes
  Signs off DEC Standards.

- Maintains Reliability Prediction System

- Engineering representative on Product Safety Committee

When Should You Contact the Office of Chief Engineer?
Whenever you need help in the areas for which the Office of Chief Engineer is responsible.

What Can the Office of Chief Engineer Supply to You?
Guidance and direction.

Reference Material
DEC Standards:
007, Design Review Process
008, Project Scheduling System
012, Inventory Class Codes
139, Reliability Prediction

3.11 POWER AND PACKAGING SYSTEMS
The Power and Packaging Systems organizational structure, individual responsibilities, and inter-group relationships are described in the following paragraphs.

3.11.1 Industrial Design Group, Manager Dick Schneider
The Industrial Design group develops and maintains product designs that have a broad application. Services encompass related aspects of:

- Aesthetics
- Human Factors
- Product Concepts
- Product Related Graphics

Aesthetics – Develop a distinctive and attractive appearance that connotes a high quality product and is appropriate to the end-user environment. The major concern is to establish a strong "look-alike" relationship throughout the Product Lines.

Human Factors – Ensure that products are: (1) easy to understand; (2) convenient, comfortable, and safe to use; and (3) man-machine interface is an efficient part of the design concept.

Product Concept – Ensure that the basic configuration of the product, i.e., its structure, materials, finish, physical and mechanical characteristics relate to other products in serviceability and cost effectiveness.

Product Related Graphics – Concerned with product identification graphics such as nameplates, control graphics, packaging graphics in relation to shipping cartons; specifically, small unit type packages that are inserted into larger cartons. Selection and control of color of products.

When Should You Contact Industrial Design?
Early contact, during the conceptual stage of your product affords Industrial Design:

- the time they require to study and understand your needs and to relate your product with other products within the company.

- time to study alternative approaches.

What Industrial Design Can Supply to You

- Help in developing instructional material for non-technical users.

- Generate mock-ups, models, and prototypes.

- Integrating function in developing the functional aspects of the product:
  Cooling
  Cabling
  New material identification and evaluation
  RFI compliance
  Manufacturing considerations

What Industrial Design Needs From You
Informal contact to describe your needs, which results in Industrial Design providing you with a detailed proposal of their services.

3.11.2 Mechanical and Industrial Packaging Group, Manager Jim Lawrence
Mechanical and Industrial Packaging is represented by four individual groups, each responsible for specific functions as indicated below.

3.11.2.1 Advanced Development – Jim Michniewich – The Advanced Development group performs development and support functions in the following areas:

- Interconnection Products
  Connectors
  Busing
  New backplane techniques
  New high-power connectors
  Cables and data interconnections

- Heat Transfer
  Design forced air ducts and heat exchanger cabinets
  Enclosure evaluation
  Thermal and air flow measurements

- Materials and Processes
  Support wet process development for PC fabrication
  Propose and develop new ECO and board fabrication process
  New module assembly process evaluation development
  New material evaluation
  Monitor and disseminate information about new materials, application, and reliability

- Support of Existing Cross-Products Packaging Enclosures
  Upgrade and modify existing products to meet evolving international safety and regulatory requirements
  Support manufacturing process of mechanical assemblies
  Analyze, evaluate, and resolve problems identified by Field Service and Manufacturing that relate to existing mechanical products

When Should You Contact Advanced Development?
During your product concept stage.

What Advanced Development Can Supply to You
Help in solving related problems concerning evaluation of new materials, new mechanical processes, air flow devices and cooling, new interconnection concepts, and cabling.

What Advanced Development Needs From You
Contact from you to discuss your needs and/or problems.

3.11.2.2 New Packaging Systems - John Groark and Steve Zabinski - New Packaging Systems is involved in implementing, developing, and designing new mechancial packaging concepts that include:

- Cabinets
- Logic enclosures
- Mechanical enclosures for peripherals

The group also:

- Develops general guidelines and standards for inter- and intra-cabinet cooling, cabling, and stability.

- Provides a central mechanical engineering resource pool to support new products on a project-by-project basis.

- Provides consultation on packaging problems encountered in designs by other groups.

- Designs and develops a family of packaging product enclosures that meet broad cross-product requirements.

When Should You Contact New Packaging Systems?

- Whenever you wish to understand existing family of packaging products which may be applicable to your new design
- When you need mechanical engineering resources that do not exist in your group.

What New Packaging Systems Can Supply to You
Expertise in the implementation, development, and design of new mechanical concepts.

What New Packaging Systems Needs From You
A description of your needs and advanced notice if you require help from the Central Mechanical Engineering Resource Pool.

3.11.2.3 Environmental Engineering – Frank Grimaldi – Environmental Engineering is responsible for:

- Maintaining and updating DEC Standard 102, Environmental Standard for Computers and Peripherals
- Providing expertise related to shock and vibration measurements.
- Evaluating the fragility of DEC products
- Interacting with the design team and influencing the structural integrity of the product
- Recommending cost effective tradeoffs between mechanical packaging and protective packaging in getting product to the customer site (shipping packages)
- Providing guidance and the ability to test at high and low temperatures
- Conducting humidity tests
- Providing expertise and guidance for acoustical engineering
- Driving engineering groups to design cost effective products through pre-defined requirements.

When Should You Contact Environmental Engineering?
Whenever you need help and guidance in environment related specifications, tests, and design.

What Environmental Engineering Can Supply to You

- Definition of test plans to meet specifications
- Troubleshooting known field problems

What Environmental Engineering Needs From You

- Funding for engineering evaluation tests
- Test specifications

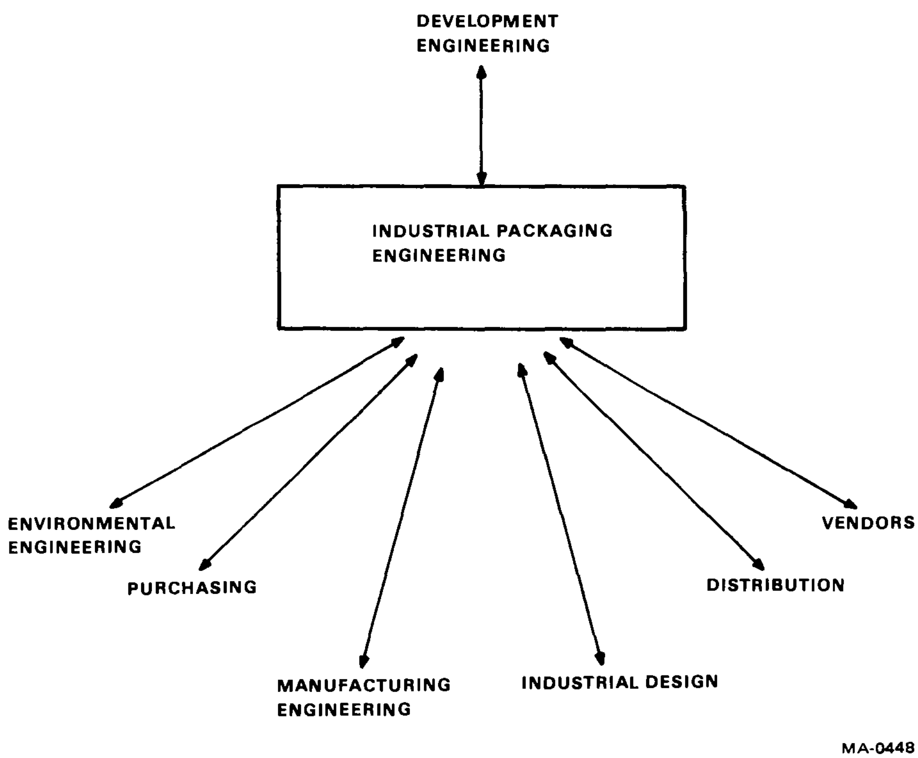
3.11.2.4 Industrial Packaging - Larry Nielsen - The Industrial Packaging (shipping package) Engineering group designs packages for:

- Shipping between facilities (piece parts)
- Subassemblies or finished products
- Moving products within a facility
- Finished products that serve the needs of Field Service Support and plant to customer shipments
- Products that DEC purchases from outside vendors; ensuring that they are adequate and effective for DEC use (consulting with outside vendors)

Industrial Packaging also:

- Works with the Purchasing people and qualifies new materials for use by the corporation
- Supports 80% of the facilities with packaging for manufacturing products
- Builds prototype samples of new product designed packages
- Complete evaluation of vendor packaging.

When Should You Contact Industrial Packaging?
Whenever packaging services are required for your product. Interface between the following groups must be established.



What Industrial Packaging Can Supply to You

- Packaging for your product
- Component Engineering function in generating Purchase Specifications for all packaging materials
- Packaging procedures for all stages of packaging
- Sign-off responsibility to Packaging Purchase Specification
- Quote of cost and schedule in writing (requires written approval of person delegated to approve funding)

What Industrial Packaging Needs From You
Funding and consultation in defining the scope of the project.

3.11.3 Corporate Power and RFI Development - Paul Rey

3.11.3.1 Corporate Power - Paul Rey - Corporate Power assures that DEC develops the optimum strategy for its internal power supply business and remains aware of emerging power system and power supply techniques.

When Should You Contact Corporate Power?
During the concept stage of your product. This allows Corporate Power, in conjunction with Power Supply Engineering, High Volume Manufacturing, and Field Service to establish Corporate Power Supply strategy to develop a business plan and implement it.

What Corporate Power Can Supply to You

- In conjunction with Power Supply Engineering, promote the use of proven, reliable power supply techniques and hardware.

- Design, breadboard and test new cost effective power supply techniques and disseminate this information for future project applications.

What Corporate Power Needs From You
A description of your needs and the Project Plan.

3.11.3.2 RFI Development - Peter Boers - RFI Development assures that DEC products are designed and manufactured to provide effective reliability relative to industry and government RFI requirements and regulations in the most timely and cost effective fashion. Also maintains and updates DEC Standard 102, Section 7 - EMI Electromagnetic Interference.

When Should You Contact RFI Development?
During the development stage of your product when RFI consultation and testing services are required.

What RFI Development Can Supply to You

- Consultation and testing services (provided to all hardware groups).
- An RFI test room at each engineering center, manned by engineers and technicians travelling to these centers on a scheduled basis.
- Test rooms as design tools, with sufficient instrumentation for design guidance.
- A certification type RFI test facility, located in the existing screen room in Marlboro, or as part of a central environment test facility within twenty miles of Maynard, MA.

What RFI Development Needs From You
A description of your needs and the Project Plan.

3.11.4 Power Supply Engineering - Henk Schalke

Power Supply Engineering designs and introduces power supplies, power controllers, regulators, battery backup modules, and power distribution assemblies into production. The group also provides cost reduction opportunities and product enhancement through the adaptation of different product technologies.

When Should You Contact Power Supply Engineering?
In the early stages of your project and during packaging of your product, at which time trade-offs on technology, packaging concepts and requirements, and partitioning of the power system are implemented.

What Power Supply Engineering Can Supply to You

- Consultation and evaluation of externally purchased products
- Support of Cross-Products power supplies from a Field Service and Manufacturing vantage point
- Consultation and Design Review services for power supplies designed by other groups
- Establish review and update standards and guidelines in:
  AC/DC power receptacles
  DEC Standard 002, AC Power Wiring, Grounding, Receptacles, and Nameplates
  DEC Standard 102, Environmental Standard for Computers and Peripherals
  DEC Standard 122, AC Power Line Standard
  DEC Standard 123, Power Control Bus Standard
- Consultation on ac power installation requirements; work with Field Service and customers on possible power distribution systems
- Monitors and phases into DEC equipment, international regulations, safety and power related regulations
- Coordinates with RFI and EMI regulation groups on DEC equipment related issues.

What Power Supply Engineering Needs From You
Informal contact to discuss issues and techniques applicable to your product needs and requirements.

References and Requisites that Help Make a Good Relationship
DEC Standards 002, 102, 122, and 123.

3.12 TECHNICAL DIRECTOR, SOFTWARE DEVELOPMENT

The chief responsibilities of the Technical Director, Software Development are to:

- Coordinate and manage an overall Technical Strategy for Software Development. The strategy guides DEC's various developers and managers by providing a clear statement of Software Development goals and the manner in which they intend to achieve those goals.

- Develop an Advanced Development and Technology Program
- Manage and chair the Technical Steering Committee
- Coordinate and review Migration and Compatibility plans
- Ensure consistent and effective Software Quality Management across the Software Development organization

The functions and responsible persons reporting to the Technical Director, Software Development, are shown in the following organization chart.

TECHNICAL DIRECTOR, (BILL KEATING)

- METHODS AND TOOLS (SEE SECTION 3.12.1)
  (BILL SEGAL)
- CORPORATE AND SOFTWARE STANDARDS (SEE SECTION 3.12.2)
  (PAT WHITE)
- SOFTWARE QUALITY METRICS AND TECHNICAL INFORMATION
  (DAVID GREENLIE)
- SOFTWARE QUALITY
  (DOM LACAVA)
- POLICIES AND PROCEDURES
  (GLADYS PANNELL)
- HARDWARE/SOFTWARE COORDINATION
  (BARRY RUBINSON)

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When Should You Contact the Technical Director's Functional Representatives?
Whenever you need information, assistance, or consultation in any of the functional areas given in the chart above.

Technical Strategy is a major consideration in all phases of Software Development. Several underlying principles are key to the group's success.

Understanding
: They must understand the industry technology, the market environment, their own limitations, and all other important issues.

Growth
: Because they are creating for the future, they must be continually looking ahead. They must recognize that what is right for today may not be best for tomorrow.

Communication
: They will communicate openly and thoroughly within DEC and externally to their users. In a complex environment, open, complete, current, communication is essential.

Execution

They will do what is necessary to develop the right products and bring them to the right marketplace.

Manageability

Work toward easing the manageability of their projects through promulgation of engineering disciplines, teamwork, conformance to standards, policies, and procedures, and by other suitable means.

What the Office of Technical Director, Software Development, Can Supply to You

- Information about the Standards, both internal and external, that affect your project. DEC Software Standards Notebook, DEC Standard Reference Pamphlets, Standards Libraries. (See Section 3.12.2 for further discussion concerning Standards.)

- Review of Project Plans and Functional Specifications for conformance to corporate compatibility goals and industry standards.

- Information about Methodology, the collection of methods, procedures, and tools for the development of software and its associated documentation. (See Section 3.12.1 for further discussion concerning Methodology.)

- Assistance in resolving issues regarding quality, service, distribution, and release of software.

- Information about software quality through an analysis of surveys, support costs, and error rates.

- Consultation on Software Quality Management

- Consultation on Metrics for Software Performance

- Sources of information and advice on technical issues pertaining to effective product development and project management

- Information on current and past technical activity from the Document Index of the Software Engineering Technical Archives

- Information about policies and procedures. The Software Development Policies and Procedures manual

- Assistance in resolving issues regarding hardware design, interaction, and performance

- Information about current and future hardware development activity

- Information about technological trends and futures.

What the Office of Technical Director, Software Development, Needs from You

- Clear statements of the issues to be resolved
- Continuous, current overview information on projects and products
- Perceived internal and customer response to DEC Technical Strategies.

3.12.1 Software Engineering Methods and Tools (Prime Contact: Bill Segal)

The Methods and Tools Department in Software Engineering is composed of the following groups.

METHODS & TOOLS (MANAGER, BILL SEGAL)

- DEVELOPMENT METHODS (STEVE GUTZ)
  (BLISS, METHODOLOGY)
- MICROWARE (CELESTE MAGERS)
- PERFORMANCE EVALUATION (JIM HUGHES)
  (DIAMOND)
- ASSEMBLER DEVELOPMENT (DALE ROEDGER)

MA-0498

The Methods and Tools Department enhances and develops software methodology and tools in order to increase programmer productivity, lower software product life cycle costs, and increase software quality.

Descriptions of the four areas of current activity follow.

Development Methods (Prime Contact: Steve Gutz)

The Development Methods group is composed of two functional areas: BLISS (a programming language specifically designed for implementing system software) Development; and Software Methodology.

- BLISS Development – This group is responsible for the development and promulgation of BLISS as a corporate high level implementation language. The group also develops compilers, support tools, and documentation for BLISS. The BLISS language was developed to support DEC hardware in a manner which allows structured programming, a high level of optimization and transportability across DEC hardware lines. Documentation, training, consulting, and access to a BLISS machine for development purposes is provided for anyone interested.

- Software Methodology – This group's primary focus is to provide methods (standards, coding practices, etc.) and tools to help decrease the life cycle costs of Software Development. They are interested in working with any development group to explore the tools and practices that they are currently using. They want to be a focal point for new ideas concerning software methodology and practices.

Microware Group (Prime Contact: Celeste Magers)

Microware encompasses microprogramming for central processors and programming for microprocessors. The group is responsible for providing software support and tools to in-house engineering groups using microprocessors, such as the Intel 8080, in their product designs or in developing microprocessors.

When Should You Contact the Microware Group?

- Early in your product planning cycle. The group may require lead time in providing the tools you need for your project.

- Whenever you have a question about microprocessors

- For information or advice as soon as you determine that your work will involve microprocessors such as the Intel 8080 or the LSI-11

- If you need microprogram development tools, such as compliers, assemblers, etc.

What the Microware Group Can Supply to You

- Consultation and education throughout the microprocessor firmware development and support cycle, including help in the software aspects of:
  Microprocessor – project planning, selection, hardware/firmware trade-offs
  Design and development of product firmware
  Selection and use of tools to aid firmware development and debug.

- Well documented and supported general-purpose tools for the development of microprocessor-based applications, including compilers, assemblers, debuggers, loaders, simulators, and utilities.

- Information related to microprocessors, including:
  Manuals for the most commonly used microprocessors within DEC
  Leads on industry available courses, books, design aids, and tools for microprocessors
  Recent trade journal articles and papers of interest to microprocessor users
  DEC internal tools available for microprocessor users

- Develop and sponsor standards, guidelines, and procedures (as they become available) for:
  Managing a microprocessor project effectively
  Developing sound microprocessor software
  Releasing and maintaining products containing firmware

What the Microware Group Needs From You

- Knowledge of your plan to use a microprocessor
- What tools you need, when you need them, and for what processor
- What your present and planned resources are
- Which individual in your organization will act as liaison
- Some of your people to act as reviewers of, and contributers to, the work the Microware group is doing regarding microprocessors, such as reviewing proposed tools specification.
- Funding for project-specific development and maintenance of tools or programming performed for your cost center.

Performance Measurement Group (Prime Contact: Jim Hughes)
This group is responsible for coordinating hardware and software development, hardware manufacturing, and overall support activities for the DIAMOND project. (DIAMOND is a hybrid performance measurement system designed to aid systems programmers, hardware evaluators, and system architects in examining the behavior of a product as quickly and simply as possible.) The group has prime responsibility for DIAMOND software development and for the integration of DIAMOND measurement systems with the PDP-11-based systems to which it may be attached as an in-house software development tool.

Other functions include documentation, user training and support, and development of the methodology of using DIAMOND.

When Should You Contact the Performance Measurement Group?
Contact should be made on any issue affecting the integration or use of a DIAMOND measurement system, including both hardware and software.

What the Performance Measurement Group Can Supply to You

- Information on DIAMOND measurement systems
- Expertise on the application of DIAMOND as a development tool.

What the Performance Measurement Group Needs From You
A description of the issue to be resolved.

Assembler Development and Support (Prime Contact: Dale Roedger)
This group is responsible for the development and support of PDP-11 based macro assemblers. Their primary function is the support of MACRO-11 and MACRO-11/700.

When Should You Contact the Assembler Development and Support Group?
Whenever there is a requirement to enhance one of our existing macro assemblers.

What the Assembler Development and Support Group Can Supply to You

- Advice on the syntax of new directives and/or instructions
- Advice and implementation of performance enhancements.

What the Assembler Development and Support Group Needs From You
A description of the problem to be solved which includes any and all trade-off possibilities.

3.12.2 Software Standards and Compatibility (Prime Contact: Pat White)
The Software Standards and Compatibility group manages all of DIGITAL's participation in standards committees sponsored by the American National Standards Institute (ANSI). The Standards Manager defines guidelines for participation and funds travel for DEC representatives. DEC representatives are chosen from the line organizations by the Standards Manager and the appropriate Development Managers.

Software Standards establishes standards committees within DEC to develop DEC standards and recommend corporate positions on industry standards. These committees have membership from Central Engineering, Central Software Development, Product Management, Product Lines, Field Service, and Software Support, as appropriate.

When Should You Contact Standards and Compatibility?

- If you are unfamiliar with DEC or industry standards that may apply to your product, you should contact Standards and Compatibility when you are writing the Project Plan. The Standards group can provide information about all U.S. and International hardware and software standards, except safety standards and regulations.

- Any time you want information on DEC's involvement in industry standards committees. Call the Standards Manager if you want to represent DEC on an industry committee or want to be on the interest list to review industry standards.

- When you want help with the process of getting a DEC standard reviewed and approved.

- When you need to know whether a DEC product conforms to ANSI, ISO (International Standards Organization), or FIPS (Federal Information Processing Standards).

What Standards and Compatibility Can Supply to You

- Standards Reference Pamphlet - A pocket-size pamphlet that lists DEC and industry standards by subject. Both approved and pending standards are included with codes that indicate status and how to order.

- Standards Summary - Contains brief abstracts of DEC and industry standards, and probable schedules for all pending standards. Gives the DEC contact for each standard. Does not include standards relating to drafting, micrographics, or corporate processes.

- Software Standards Notebook - Contains all approved corporate software-related and software documentation standards. Also includes a description of the standards process, abstracts of ANSI and ISO standards, and a complete listing of DEC corporate standards. The Software Standards Notebook is distributed by subscription and updated approximately on a quarterly basis.

- Standards Reference Libraries - Software Standards maintains a small library in each geographical location of Software Development; currently in Maynard, Marlboro, and Hudson, New Hampshire.

- Standards Status Report - Includes a monthly status report covering all pending software-related standards and industry standards. Review dates for DEC and industry-related standards are announced.

- Consultation Service - Consultation on the interpretation of industry standards or referral to a DEC expert. Review of Project Plans, SPDs (Software Product Descriptions), and selected functional specifications to identify standards and compatibility issues. Consultation on the standards process is also available.

- Interest Lists - Maintains interest lists of people at DEC who are interested and qualified to comment on various standards subjects. These lists can also be used as a source of names for Design Reviews for related products.

- Draft Standards - Drafts of DEC software standards and industry standards (ANSI, CODASYL - Conference on Data Systems Languages - ISO, FIPS) are available from Standards and Compatibility and from Standards Libraries.

- Standards Presentations – On request, the Standards and Compatibility group makes presentations to internal groups and to customers on standards issues.

- Help With DEC Standards – The group can provide help in starting standards projects and in resolving issues. Standards and Compatibility can provide professional technical editing, text preparation, printing, and distribution of selected standards.

- Standards Process Documents:

  The Software Standards Process (Software Development Policy 7B1-1.A)

  Format for Software Standards (Software Development Policy 7B1-2.A)

  ECO/Revision Control of Technical Specifications and Proposed DEC Standards (Software Development Policy 7B1-11.A)

  Participation in Standards Committees (Corporate Policy 75-7).

What Standards and Compatibility Needs From You

- Copies of Project Plans for all products that would be affected by industry standards, including all software products, terminals, I/O systems, instruction sets, and diagnostic systems that run under standard operating systems.

- Provide the group with an opportunity to review all SPDs that cite conformance to standards. An SPD is a legal commitment to conform as defined in the standards document.

- Your cooperation in reviewing proposed DEC and industry standards that affect your product area.

3.13 SOFTWARE DEVELOPMENT SERVICES

Software Development Services' functions are described in the following paragraphs.

Software Publications (Marlboro Manager, Steve Heiser; Maynard Manager, Laura Varteressian; New Hampshire Manager, Norm Brimhall; Tewksbury Manager, Armen Varteressian)

Software Publications provides:

- Planning, writing, editing, and production of user documentation describing the concepts, functions, operations, and usage of DIGITAL software products.

- Group responsibility for the style, format, readability, and usability (human engineering) of DIGITAL user software documentation.

- Establishment and maintenance of procedures for evaluating documentation quality in the areas of responsibility identified in the previous paragraphs and to improve the quality of documentation based on those evaluations.

- Investigation of new procedures and methods for improving the readability and usability of software documentation.

- Development of documentation guides and standards, and establish editorial conventions as a means of achieving uniformity and consistency across all software documentation.

- Scheduling for all Software Publications activities and implementation of documentation programs in a timely, cost-effective manner by means of early interfacing with all participating organizations.

- Registration of an equal voice with other participating organizations in decisions affecting project resources, quality objectives, and delivery schedules.

- Promotion of documentation compatibility among compatible software products, hence advancing corporate standardization objectives.

- Promotion of timely, effective review of documentation by participating organizations in order to ensure adequacy and accuracy of manual content.

- Maintenance of a close professional relationship with other document-producing groups within DIGITAL, e.g., Technical Documentation, Product Promotion, Educational Services, Marketing, etc. Suggestions of methods by which all document-producing groups may interact to promote corporate documentation compatibility, consistency, and uniformity.

Software Publications Methods Group (Laura Varteressian)
Software Publications has developed effective tools for measuring the readable quality of technical documentation. The Software Publications Methods Group provides:

- Objective analyses of the quality of software publications
- Constant monitoring and upgrading of the effectiveness of the measurement criteria.

Software Document Preparation (Cheryl Hogan)
This group produces all draft copies used for technical reviews, incorporates all changes, and produces camera-ready copy.

- Data Entry Technicians input and edit text.

- Proofreaders check for typographical errors, format, and grammatical accuracy.

- Technical Illustrators produce technical and creative art.

- Administrative/Clerical personnel prepare instructions for the printers and maintain a central filing system of all document masters.

Software Distribution Center (SDC) (Manager, Ed Wright)
The SDC Group is responsible for the worldwide administration, reproduction and distribution of all DIGITAL software products except custom-built programs for special systems and typeset hardware.

The SDC consists of five functional groups:

- Software Manufacturing Control (Gil Napoleon)
- Order Processing and Administration (Charles Mallett)
- Manufacturing and Distribution (Burt Brown)
- DECsystem-10 and -20 Software Manufacturing (Bob Baillie)
- European Software Manufacturing and Distribution (Rob Vensel).

The SDC group provides services for customers, Sales personnel, Product Lines, and FA&T (Final Assembly and Test) facilities. The SDC group also supplies remote distributorships with software components for resale, and maintains a protection and retrieval system for the corporation to ensure against loss of software products. The SDC group also maintains a protection system that ensures against shipment of software products to unauthorized, non-licensed users.

The SDC performs the following functions:

- For FA&T
  Order processing, scheduling procurement, and manufacture (if necessary) of all media and documents for system and diagnostic software

  Procurement and distribution of all FA&T print set requirements, hardware manual requirements, microfiche requirements

- For DEC offices and remote distributorships
  All order processing, scheduling, procurement (if necessary) of all system and diagnostic software kits and their component parts to demand

- For Customers
  Same services performed for DEC offices, plus a customer assistance desk for follow-up on problem orders and order status

- Corporate Services
  Maintain under fire-safe storage all past and presently released software products and their documents on file to facilitate disaster recovery

  Maintain and publish a corporate catalog of all component parts of all software available for purchase from DIGITAL.

Computer Resources and Facilities Management (Manager, Don Crowther)
This group plans for, acquires, and manages the computer resources and services to support the requirements of the Software Development and Production groups.

The Computer Resources and Facilities Management Group has four major areas of activity:

- Administration/Finance
- Operations
- Facilities Management
- Technical and Networks.

Administration/Finance responsibilities:

- Prepare and process all capital equipment orders
- Prepare and distribute order status reports
- Prepare and distribute utilization bills and other related reports for general purpose equipment
- Forecast equipment needs.

Operations responsibilities:

- Provide computer operator coverage at the required facilities
- Assist users with operational and procedural problems
- Schedule all general purpose equipment and assist in scheduling specialized equipment
- Monitor facilities activities and take corrective actions when necessary
- Provide media library service.

Facilities Management responsibilities:

- Ensure proper power and air-conditioning
- Configure equipment orders
- When appropriate, implement standard and non-standard solutions to users' problems, i.e., the terminal patch (a patch block located in the computer area which allows the user to switch to different computers from an office terminal), and the peripheral pool (an 11/10 and 11/50 interconnected to allow access to various peripheral devices).

Technical and Networks Support responsibilities:

- Analyze users' needs; compare needs with capabilities of users' current resources; recommend how to optimize resource use
- Correct, if possible, deficiencies which surface or work with appropriate support groups to resolve technical issues
- Perform special functions in support of operations and administration
- Create and maintain computer systems designed to improve and measure the effectiveness and productivity of the computer resources
- Feedback to the developers based on actual usage.

3.14 REAL-TIME/COMPUTATION SOFTWARE SYSTEMS

The Real-Time/Computation (RT/C) Software Engineering organization is responsible for assessing the needs of the scientific sensor-based, real-time and computation marketplaces, determining how best to meet those needs in order to maximize the return to DIGITAL on its Software Engineering dollar, and the implementation of the products thus specified. While primarily software-oriented, RT/C has interfaces with all key hardware organizations, thus ensuring that all products of Central Engineering are "systems"-oriented.

Group Interface

Interface is generally a two-way street that starts early in the planning phase to ensure proper understanding and design trade-off interaction early enough to affect the design of both hardware and software products.

RT/C interacts with other engineering organizations, both inside and outside Central Engineering. Such interaction takes place during all phases of product development, since there is usually engineering interdependency across organizational lines.

What RT/C Can Supply to You
RT/C is composed of three functional groups:

- Product Management - Contact: Jack Mileski - This is the business wing of the organization responsible for assessing market application needs and translating that into product requirements. It also interfaces with Product Management organizations in other areas of Central Engineering to ensure the success of interdependent products.

- RT/C Development Organizations are divided into:
  Small Systems - Contact: Gil Steil
  Medium-to-Large Systems - Contact: Bill Munson.

  These organizations produce the actual code and manage the overall technical inter-dependencies required to turn out a total systems product.

- The third functional group includes:
  Documentation - Contact: Armen Varteressian
  This group is responsible for the production of user documentation.

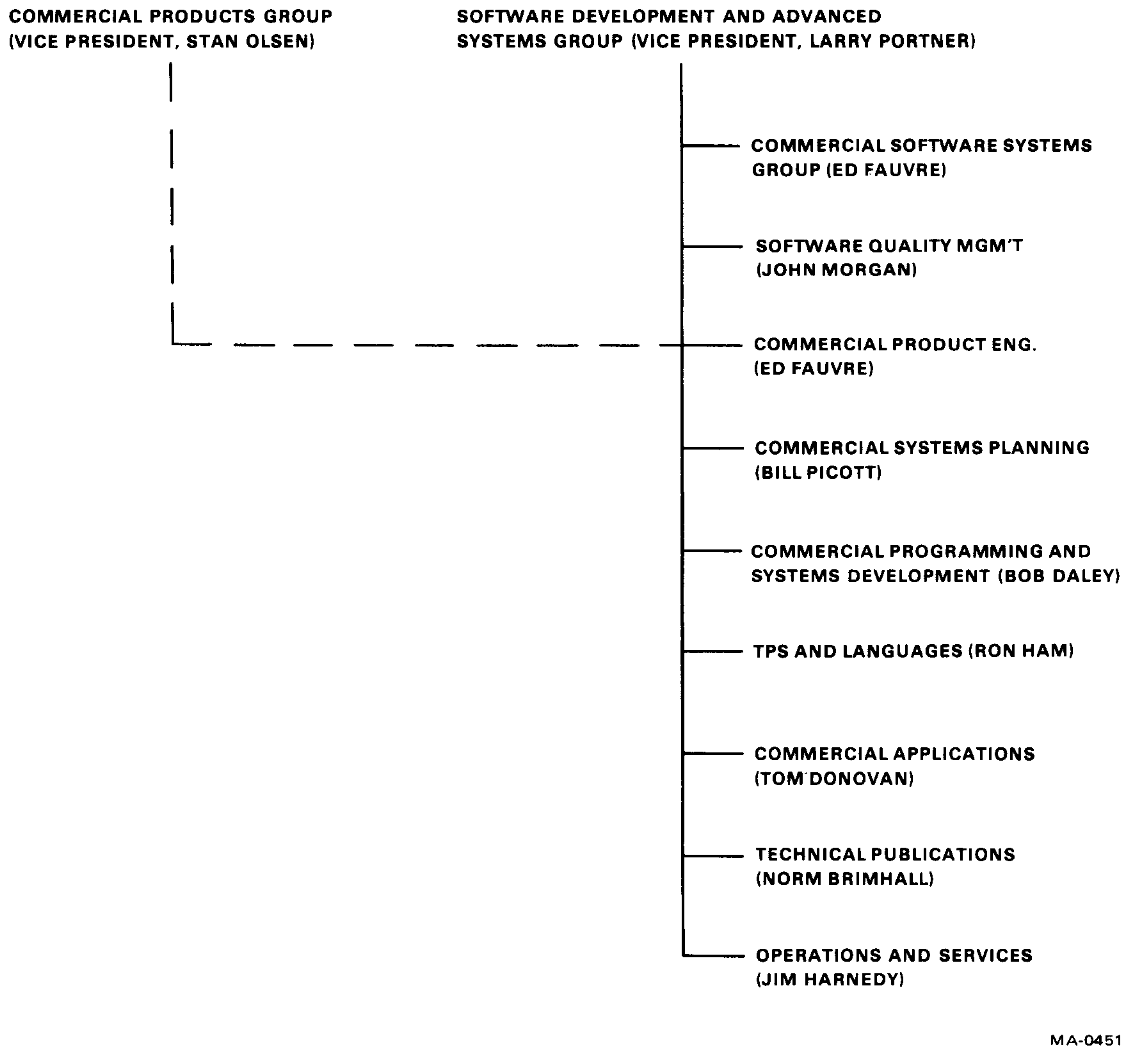
  Software Quality Management (SQM) - Conact: Brad Glass
  This group is responsible for ensuring that RT/C quality plans and test procedures meet DIGITAL Standards.

3.15 COMMERCIAL ENGINEERING

The Commercial Software Systems group comprises a number of development functions and diverse services, many of them software, and some hardware. Their prime mission is to make high quality commercial systems and products a reality within DIGITAL's total commercial marketplace. Thus, the group's focus is on total program/system implications and integration issues, as well as life cycle costs. To implement this objective, the group is responsible for taking Product Line commercial market requirements, merged with technological opportunities, and translate these into integrated system strategies for centrally developed products, and to be responsible for the success of these products.

The group's major development efforts are in commercial small systems, commercial time-sharing systems, transaction processing systems, languages, compilers, data management, data base, application software, as well as in the development of tools and methodology, program management, and the coordination and integration of all of DIGITAL's centrally developed commercial systems and products, as well as those applications of interest to specific Product Lines. To help ensure the timely delivery and maintainability of high quality commercial systems and products, the group provides the appropriate mix of professional, administrative, logistical, and technical support.

The Commercial Products group engineering activity provides a total group engineering function to manage, either directly or by influence, the hardware and software technical effort. Key activities currently include: coordination and optimization of technical activities between Product Line engineering organizations and Central Engineering groups; provide technical resources to solve specific Product Line engineering development problems; conduct Schedule Reviews; communicate system, program, and product development activities between various Product Lines within the Commercial Products Group; and develop an environment that allows synergy to take place across all Commercial Engineering-oriented groups.


COMMERCIAL PRODUCTS GROUP (VICE PRESIDENT, STAN OLSEN)
SOFTWARE DEVELOPMENT AND ADVANCED SYSTEMS GROUP (VICE PRESIDENT, LARRY PORTNER)
COMMERCIAL SOFTWARE SYSTEMS GROUP (ED FAUVRE)
SOFTWARE QUALITY MGM'T (JOHN MORGAN)
COMMERCIAL PRODUCT ENG. (ED FAUVRE)
COMMERCIAL SYSTEMS PLANNING (BILL PICOTT)
COMMERCIAL PROGRAMMING AND SYSTEMS DEVELOPMENT (BOB DALEY)
TPS AND LANGUAGES (RON HAM)
COMMERCIAL APPLICATIONS (TOM DONOVAN)
TECHNICAL PUBLICATIONS (NORM BRIMHALL)
OPERATIONS AND SERVICES (JIM HARNEDY)
MA-0451

Who To Contact

Major Systems/Programs/Products Contact List

System/Program/Product	Systems Manager	Planning Manager
Assist-11 (Directory Assistance System)	Tom Donovan	
Commercial Networks	Tom Donovan (acting)	Bill Picott (acting)
Commercial Advanced-11 System (including Advanced-11 HA/MP) (High Availability/Multi-processing)	Bob Daley	Charlie Johnson
Data Services	Ron Ham (acting)	Richard Pietravalle
Documentation	Norm Brimhall/Lee Butler	
-11 High Availability/Multi-processing	Tom Donovan	Charlie Johnson
Languages	Frank Infante	Richard Pietravalle
Maintenance	John Morgan	
PDP-15 S/W	John Morgan	
Program Management		
Hardware Liaison	Ed Fauvre (acting)	
External Project Control	Jim Harnedy	
RSTS/CIS (Commercial Instruction Set)	Bob Daley	Charlie Johnson
Small Commercial Systems	John Morgan	Ted Webber
SQM (Software Quality Management)	John Morgan	
TMS-11/CMS-11*	Tom Donovan	
TPS-11 (Transaction Processing System)	Ron Ham	Charlie Johnson
Word Processing Software	Tom Donovan	

*Typeset Management/Classified Management Systems-11

3.16 DIAGNOSTIC ENGINEERING (Prime Contact: Bill Johnson)

Diagnostic Engineering comprises the following functional areas:

DIAGNOSTIC ENGINEERING (MANAGER, BILL JOHNSON)

- MANUFACTURING TEST APPLICATIONS (BILL MORAN)
- AUTOMATION SYSTEMS (OLIVER STONE)
- PROCESS/PRODUCT EFFECTIVENESS (MARV HOROVITZ)
- DIAGNOSTIC SYSTEMS ENGINEERING (BOB BECK)
- ENGINEERING PROGRAMMING (PETE STRAKA)

MA-0500

When Should You Contact Diagnostic Engineering?
It is extremely important for Diagnostic Engineering to participate in the very early conceptual stages of the development of your product. This allows time for incorporating hardware/software trade-offs that are necessary to ensure a producible and maintainable product.

What Diagnostic Engineering Can Supply to You
Diagnostic Engineering is involved in a product from its conception through its entire life cycle and it is a tool that the engineer uses to meet the performance, producibility, and maintainability goals for the product. This is accomplished through an understanding of these goals and of the hardware/software trade-offs that can be made to afford a practical solution to these goals. During the course of the engineer's involvement in the product, Diagnostic Engineering provides the following:

- Product Concept and Project Planning Phase
  Participate in the generation of Engineering, Manufacturing, Field Service, and diagnostic plans for the product.

- Product Design Phase
  Participate in product design and assist engineer in hardware/software trade-offs and logic partitioning decisions.

- Engineering Checkout Phase
  Provide design check programs to validate hardware design per specification.

  Provide special assistance during design checkout

  Provide test software to ensure that the product can be integrated into the systems environment.

  Provide special evaluation programs as may be required by you.

- Release of Product to Engineering
  Provide semiconductor and module test programs for Manufacturing.

  Provide device and system test programs for use by Manufacturing to meet specified Manufacturing goals.

- Release of Product to Manufacturing
  Monitor product flow through Manufacturing test areas for program efficiency and detection of improvement possibilities.

  Provide timely updated test programs to Manufacturing that reflect the latest ECO activity on the product.

  Review test procedures to ensure that they are suited to the skill levels of the users, and interact with Manufacturing and Engineering on improvements.

- Shipment of the Product to Customers
  Provide maintenance programs to Field Service in accordance with specified maintenance goals.

  Provide continued sustaining support for the diagnostic programs during the life of the product.

What Diagnostic Engineering Needs From You

- A Project Plan and project leadership to coordinate the efforts of the other project team members.
- Concept review, design reviews, design specifications, schedules, project reviews, etc.
- Funding to support product development and maintenance effort for diagnostic programs.

3.17 DISTRIBUTED SYSTEMS AND COMPONENTS GROUP

The Distributed Systems and Components group has responsibility for all DECnet products for all families of computers, the central software engineering for the DECsystem-10/20 computer families, and serves as the Central Engineering interface to the European Software Engineering (ESE) group for remote software development. This is reflected as follows:

operating systems
data services
languages
utilities } DECsystem-10/20
networks and communication - All corporate software products
management of contractual software development by ESE.

The Distributed Systems and Components group is functionally organized into four direct reporting groups. The total organization is as follows:

DISTRIBUTED SYSTEMS AND COMPONENTS (GEORGE PLOWMAN)

- DISTRIBUTED SYSTEMS PRODUCT MANAGEMENT (CHUCK STEIN)
- DISTRIBUTED SYSTEMS SOFTWARE ENGINEERING (MARY BRESLIN)
- DECSYSTEM-10/20 SOFTWARE ENGINEERING (ED CHRISTIANSEN) (MARLBORO)
- EUROPEAN SOFTWARE ENGINEERING (JIM WADE)
- CUSTOMER SERVICES PLANNING & DEVELOPMENT (FUNCTIONS)

MA-0512

Distributed Systems Product Management

Set up to provide a business and strategic focus for Distributed Systems software, both program and products.

Distributed Systems Software Engineering

Organized to provide the focus for the development, test, support, maintainability, and evaluation of network and communication products, centrally developed for all families of computers.

DECsystem-10/20 Software Engineering
A centrally directed, Product Line funded development organization, geographically located with the Product Line in Marlboro and responsible for the development, support, and evaluation of all standard software products for the DECsystem-10/20 family of computers specializing in operating systems, languages, and data base software.

European Software Engineering
A remote software development group located in Reading, England, and to a large part funded by Central Engineering to develop expertise and products across the full range of Central Software Engineering responsibility. Distributed Systems and Components serves as the Central Engineering interface to this group for funding management, subcontracting, and conformance to Central Engineering processes.

Customer Services Planning and Development
Represents those support organizations not reporting to Distributed Systems and Components but with whom close working interfaces have been developed which are vital to the success of the Distributed Systems program.

ORGANIZATIONAL RESPONSIBILITIES AND PERSONS TO CONTACT

Distributed Systems Product Management
Two distinct functions are provided at the program level:

- Strategic Planning - Program Manager, Nate Teichholtz
  set strategic direction for program
  develop program Business Plan
  ensure that product strategies integrate into a coherent Program Plan
  key spokesperson for the program concept and long-range plans

- Sales and Support - Program Manager, Mike Weinstein
  assure that released products are announced, promoted, sold and serviced such that the expectations match product capabilities

  develop and publish a continuing Marketing Guide

  stimulate program-related training for sales, service, and customers

Two distinct functions are provided at the product level:

- IntraDEC - Product Manager, Dick Loveland
  DECnet-11M/S
  DECnet-11D/IAS
  DECnet-RT-11
  DECnet TPS
  DECnet-RSTS-E
  DECnet 8
  DECnet 10/20

- Foreign Networks - Product Manager, Jack Zins
  2780, 3270, 3790 — Protocol Emulators
  X.25

Product level functions provide product management through the Phase Review process, product planning in coordination with both the Product Lines and the Development Manager - strategic planning, and product support in coordination with Field Service, Software Services, Sales, and the Product Lines.

An additional function is provided at the product level:

- Special Projects - Product Manager, Rick Corben
  deals with issues of architecture and long-range technology issues.

Distributed Systems Software Engineering

Development responsibilities are:

- DEC-10/20 DECnet Products - Fred Howell
  Development of all DECnet products for DEC-10/20. In addition, serves as the integration and test function for common components developed in Maynard for inclusion in DECsystem-10/20 products.

- DECnet-11 and Common Components - Norm Samuels
  Development of DECnet-11 products for RSX-11M, D, IAS, and RT-11 Operating Systems.

  Development of all components which are common to DECnet products: NSP, NCU, MCB, Gateways (NSP - Network Services Protocol, NCU - Network Control Utilities, MCB - M Communications Base — RSX-11M)

- Applicational Terminal Services (ATS)/Protocol Emulators/System Tools
  Development of generic ATS; Operating System Specific Protocols 3270, 3790, 2780; system tools for performance and testing.

Product Support responsibilities are:

- Product Support - Kami Ajgaonkar
  Primary emphasis is on shipment and support of Phase I and Phase II DECnet-11 products. This involves all aspects of internal system test and evaluation, present and planned maintainability features, field testing, and support for all released products. Correspondingly, this group serves as the primary interface with Software Services, Field Service, and Diagnostic Engineering.

DECsystem-10/20 Software Engineering
Organized into the following major subgroups:

- Operating Systems, Packaging and Release - Chuck Turley
- Languages/Data Bases/Applications - Norma Abel
- Program Management - Jim Mills
- Software Quality Management - Richard Glantz

Additionally, the following are key service group interfaces relevant to these software products:

- Software Documentation - Steve Heiser
- Diagnostic Engineering - Bob Beck

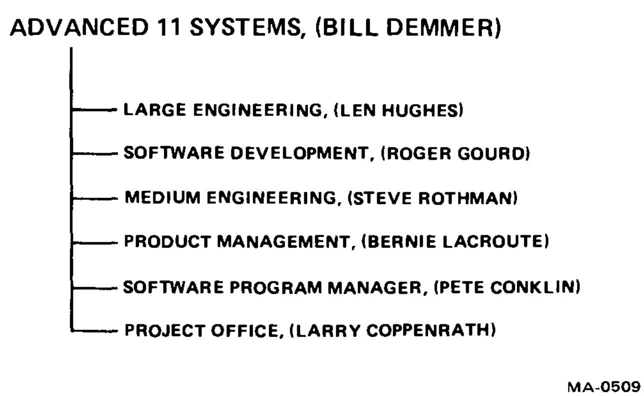
European Software Engineering
Principally organized into the following major subgroups:

- Operating Systems - Dick Davies
- Languages - Andrew Skinner
- Communications - Terry Retford
- Product Analyst - Roy Graham
- Documentation - Ken Western

Customer Services Planning
Represents major support functions that are vital to the goal of the organization to produce leadership products. The associated group interfaces are as follows:

- Software Services - Clarke Wegner and Jim Morrin
- Field Service - Mike Kalagher and Dick Pigman
- Customer Training - Bob Hymes

3.18 ADVANCED 11 SYSTEMS
The Advanced 11 Systems group is responsible for developing hardware and software for the Advanced 11 product family. In addition, the group is responsible for the integration of the Advanced 11 System to all corporate support functions that are required for DIGITAL products, e.g., Field Service, Product Promotion, and Training.



When Should You Contact Advanced 11 Systems?
Advanced 11 Systems should be contacted on any issue affecting the development or integration of the Advanced 11 product family, including peripherals and software.

What Advanced 11 Systems Can Supply to You

- Expertise on Advanced 11 hardware and software
- Information on the Advanced 11 product family

What Advanced 11 Systems Needs From You
A description of the issue to be resolved.

3.19 ENGINEERING DESIGN SERVICES

The Design Services group works with Engineering, Manufacturing, Product Lines, and various other departments in providing design assistance and documentation support related to the creation and dissemination of product design specifications. The group has a decentralized structure to accommodate engineering interface. Design Services satellites are located in the Mill Complex in Maynard, MA. (Manager, Ken Russ - ML3-6). A Design/Drafting group is located in Acton, MA., which has a direct interface with Maynard's Printed Circuit Design. Similar functions are provided in Marlboro, MA. (Manager, Roger Pothier) and Phoenix, Arizona (Manager, Jim Gillette). Plans are underway to provide these services in Merrimack, N.H. (Manager, Joe Madden) and in other future remote sites.

When Should You Contact Design Services?
Your prime contact is the satellite manager who should be informed about your project as early as possible, preferably during your planning stage to allow the time required to determine the scope of your project, type of support you need, and assistance in planning support schedules. Planning and staffing can then be established; project definition can be developed through additional meetings.

What Design Services Can Supply to You

Design/Drafting
Assists with design layouts and generates formal documentation of your idea with emphasis on accurate information that is necessary to build and verify your product and release of a product specification that is reproducible and retrievable.

Typical Support and Services Provided:

- Design Development - Design support layouts, prototype build support and project coordination

- Document Drafting - Required to formalize metal fabrication, subassemblies, assemblies, and option documents

- Electrical Drafting - Required to formalize electrical diagrams, flowcharts, block diagrams, or circuit schematic documentation.

- Checking - Dimensional applications, format, and corporate standardization

- Engineering Change - Preceding efforts reapplied because of significant change introduced late in the support activity

- Expedite - Coordination or support necessary to process a PC (printed circuit) design or prototype build

Auto Processing
Typical support and services provided are:

- Data Services - Support of either the design activity or soft tooling requirements, such as:
  Generation of tool tapes
  Photo artwork tapes
  Physical drawing (plotting) tapes
  Drill tapes
  Insertion tapes
  MIF (Manufacturing Interface File) regeneration
  CALDEC coding
  Wire listings
  Preparation and data entry
  Calcomp plotting
  ROM and PROM data entry

Printed Circuit Design
Typical support and services provided are:

- Checking } Refer to Design/Drafting
- Expedite } Support and Services
- Data Services - Refer to Auto Processing/Circuit Schematic
- Automated PC - A fully automated interactive design application, i.e., pinning, placement, routing, auto checks, MIFs and Process Forms/Data Sheets

  Interactive Design and Engineering Analysis (IDEA) - A second generation automated design system developed entirely by DEC. Provides generation of the IDEA design of PC boards.

  Computer Aided Layout by DEC (CALDEC) - An interactive tool providing automatic: (1) placement of components, (2) routing of networks, and (3) checking of special wiring rules.

  GEMS - A semi-automated process of digitizing printed circuit layout. Digitizing can consist of pencil layout digitizing, digitizing for drill from tape layouts, or manual to GEMS conversion.

- Manual PC - Manual layout and taping application and Process Forms/Data Sheets.

What Design Services Needs From You

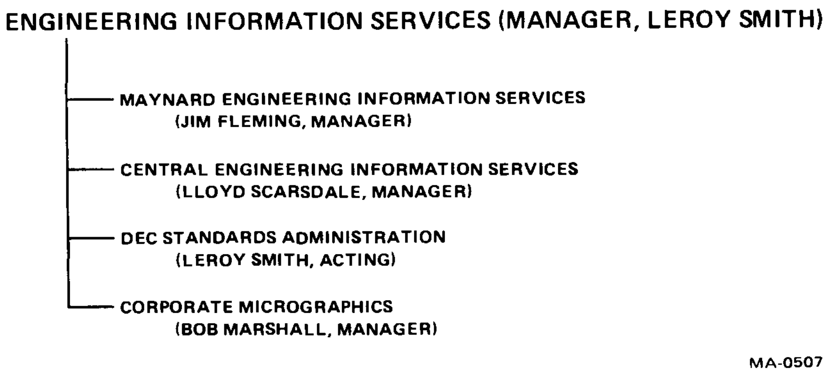
- Sketches and drawings
- Funding and Project Schedules
- An Engineering Services Work Request (for printed circuit layouts) approved by the Chief Engineer, Dick Best (ML3-2/A16, X2273)
- Engineering time - Direct interaction between you and the service group personnel who will be working on your project

References and Requisites That Help Make a Good Relationship

- Production and Engineering Services Drafting Manual
- DEC Standard 030, Module Manufacturing Specification
- Design Services Service Manual, available from Design Services Group (ML3-6).

3.20 ENGINEERING INFORMATION SERVICES

The Engineering Information Services organization is divided into four groups. The Maynard and Central Engineering Information Services groups primarily serve Engineering, Manufacturing, and the Product Lines. DEC Standards Administration serves all DIGITAL employees. The Corporate Micrographics group provides general source documentation and computer output microfilm needs of the corporation.



When Should You Contact Engineering Information Services?

Contact with the Maynard and Central Engineering Services groups is usually established via the Engineering Design Services satellites. They may, however, be contacted directly.

All requests for DEC Standards are to be submitted to the DEC Standards Control Group, located in the Mill Complex ML4-2/E27, Ext. 2954 (Contact: Doris Bellemare).

Contact is made with Corporate Micrographic Services for design of new or changes to existing micrographic systems and/or to implement a new micrographic application and for system design (Contact: Bob Marshall, ML4-2/E27, Ext. 6676).

What Engineering Information Services Can Supply to You

Maynard and Central Engineering Information Services:

- Automated Documentation – Data Entry and Support – Provides support to corporate and manufacturing for the entry and validation of data into systems such as EPLS (Engineering Product Library System). (Contact: Lloyd Scarsdale, ML4-4/E99, Ext: 8783.)

- Library Services – Receives source documents into Design Library (vault). Documents are stored, fail-safed, indexed, and are retrievable to fulfill user requests (Contact: George Bourbeau, ML4-2/E27, Ext. 4349).

- Engineering Microfilm Duplication and Distribution – Microfilm Engineering documents, duplicates, photo enlargements, and provides special handling and distribution of fiche and hard copy (Contact: Irene Fredette, ML3-2/E27, Ext. 6745).

- Engineering Reproduction – Provides the following services:
  Reproduction of documentation via request forms and window service (low volume requests, e.g., for print sets – 9 print sets/50 prints per set).

  Generation of print sets

  Copy and reduce drawings and general documentation (Contact: Al Burke, ML6C-2/E27, Ext: 8526).

- Graphics Services (Contact: Ron Fontaine, ML1-1 Ext: 3513) – Services are performed as directed by the satellite manager. If you are interested in knowing what functions are performed, refer to the Engineering Information Services Guide listed under Reference at the end of this section.

- Reprographics (ML3-2) – Provides the following services:
  Offset printing and related finishing services

  Inventory print sets and DEC STDS (Bill Weidner, ML3-2/E25, Ext: 3735).

DEC Standards
Functions include assigning and controlling revisions of DEC Standard numbers, coordinating the standard review cycle, filing original texts, microfilm, printing, and distribution of all new and revised DEC Standards. Maintains archives and distributes Manufacturing Process Documentation.

Corporate Micrographic Services

- Computer Output Microfilm (COM) – Design of COM micrographic systems and the production of computer output microfilm from magnetic tape.

- Source Document – Design of micrographic systems and the creation of microforms from hard copy/source documents.

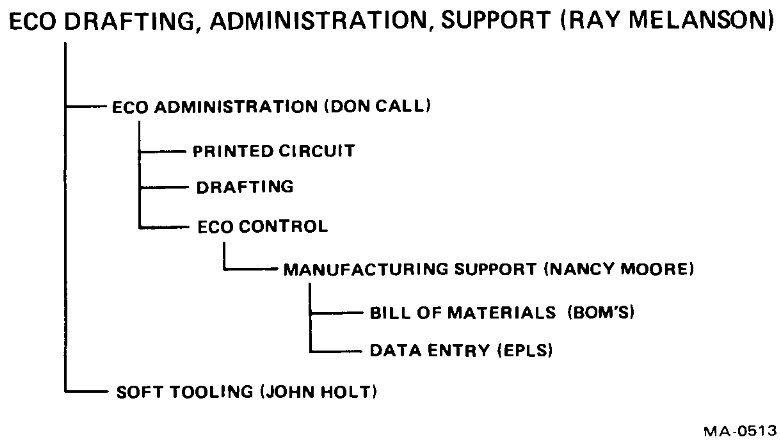
- Micropublishing – Provides large scale original and republishing on microform (microfiche) as a service to all corporate organizations.

What Engineering Services Needs From You
Request for service via appropriate request forms (refer to Engineering Information Services Guide).

Reference Material and Requisites That Help Make a Good Relationship

- DEC Standard 115, Manufacturing Process Documentation
- DEC Standard 142, Printed Circuit Release Flow
- Engineering Information Services Guide, available from the Engineering Information Services organization

3.21 ECO DRAFTING, ADMINISTRATION, SUPPORT
The ECO Drafting, Administration, Support organization is composed of two groups: ECO Administration, which is concerned with the coordination, documentation support, and distribution of Engineering Change Order (ECO) information; and Soft Tooling, which provides Manufacturing and Engineering with soft tooling (insertion tapes, numerically controlled tapes, etc.) for making production models and to drive various machines used in Manufacturing.



When Should You Contact ECO Drafting, Administration, Support?

ECO Administration
Anyone aware of any equipment/documentation deficiencies or of possible improvements may originate an ECO (see DEC Standard 100).

Soft Tooling
Manufacturing representatives may request soft tooling; insertion tapes, templates, component overlays, etc.

Engineering, Manufacturing, and Field Service may request soft tooling; wire listings, card decks, reference, maintenance checks, and manufacturing tools.

What ECO Drafting, Administration, Support Can Supply to You

ECO Administration

- Details of the ECO to affected areas for their review prior to issue of the ECO.

- Assist the responsible design engineer in gathering detailed information for the completion of the ECO Implementation Plan/Cost Worksheet.

- Release copies of the initial ECO package, which is distributed via the Engineering Reproduction section of Information Services, to all affected areas.

- Assign M98 numbers for the collection of material and labor charges incurred by manufacturing groups and verify chargebacks to Engineering Discrete Project Numbers.

- Only in support of ECOs
  Provide PC and electro-mechanical design/drafting capabilities and interact with the Model Shop, Information Services, and YOU.

  Functions are similar to Design Services; the major difference is that the ECO activity functions after release.

Manufacturing Support
This group is part of ECO Administration, however, it is functionally separate from the organization.

- Supports manufacturing in Bill of Materials update onto the EPLS file.
- Provides an audit function which identifies differences between Engineering Parts List and Manufacturing Bill of Materials.
- Provides a data entry service to include:
  Manufacturing BOMs (Bill of Materials)
  Master Parts File
  Engineering Parts Lists
  Option and Price File onto EPLS

Soft Tooling

- Procures and ships "soft tooling" for support of Manufacturing facilities including:
  Models
  Insertion templates
  Numerically controlled tapes (NC tapes)
  Drill tapes
  PC board artwork
  Wire-wrap
  AWT tapes (automatic wire tester tapes)
  Small testers

What ECO Drafting, Administration, Support Needs From You
An understanding of the ECO process. Refer to DEC Standard 100, Engineering Change Order, for the requirements and procedures to be followed in the generation of an ECO.

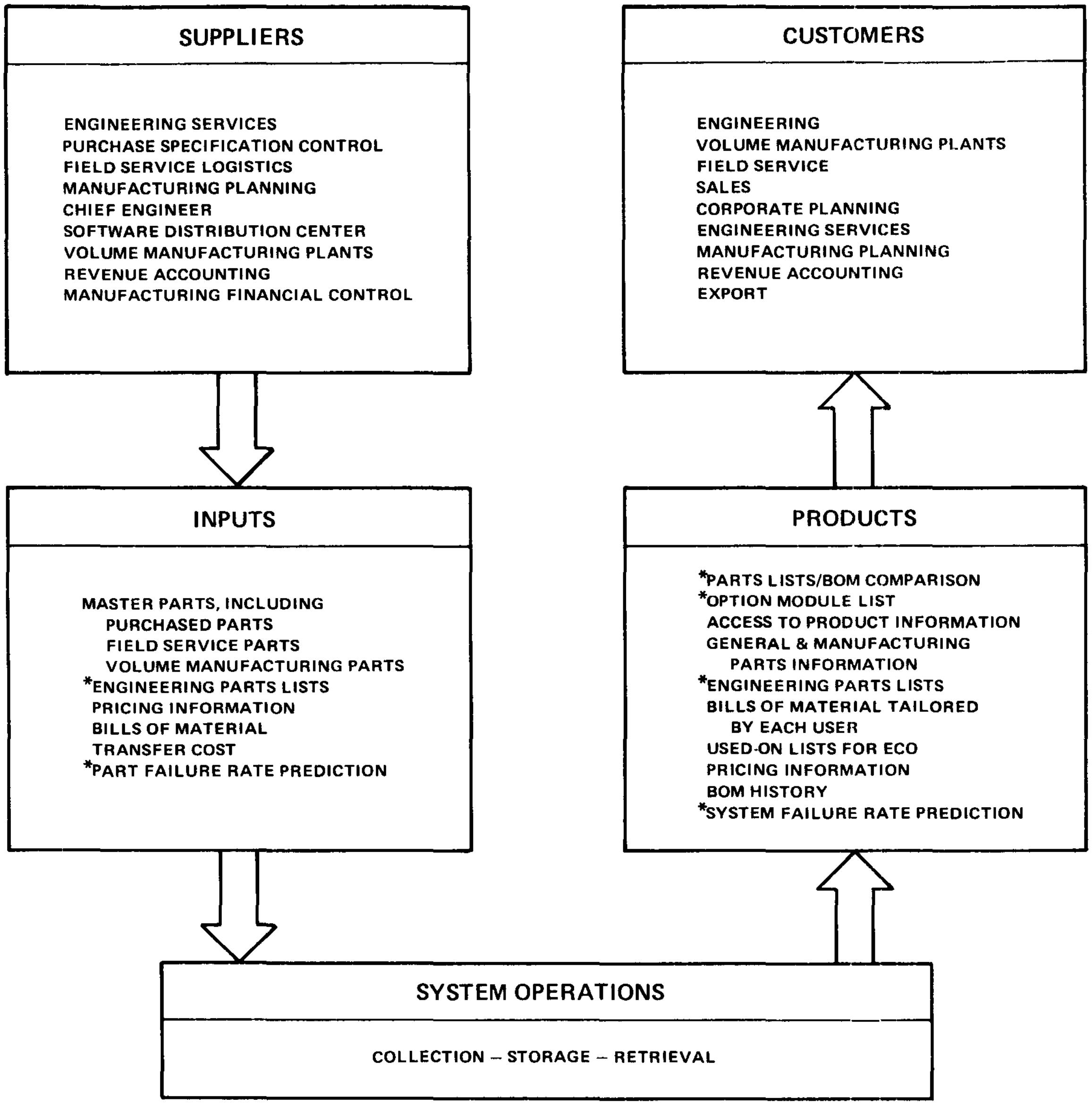
3.22 ENGINEERING PRODUCT LIBRARY SYSTEM (EPLS)

EPLS provides a central source of information about DIGITAL's products. It is a computerized data base system used for storage and retrieval of the Engineering Master Parts File and the Manufacturing BOM (Bill of Materials) data. The system functions as a recipient of information, as a business support system, and as a supplier of information. It may perform any or all of these functions for a given user. It also integrates all of the information about a product from each of its sources.

The operating philosophy of the system is that users are responsible for the validity of the information they supply. Engineering Services is responsible for the operation and development of the data processing system to support the information structure. All user needs are coordinated by Engineering Services.

When Should You Contact EPLS?
You should contact Engineering Services (Prime Contact: Sandy Briggs Ext: 8719 in Maynard) if you have any questions about the contents or use of EPLS.

What EPLS Can Supply to You
The following diagram shows the participants in, the contents of, and the information flow within the system.



*UNDER DEVELOPMENT

MA-0447

3.23 ENGINEERING EDP SYSTEMS

Engineering EDP Systems is a service organization whose functions are to design, develop, operate, and maintain information systems in support of the engineering community. This organization is part of the Engineering Operations, is project-oriented, and adaptable to changing requirements. Analysis and Reporting, Product Systems, and Software Distribution Center Support are three major projects of the current structure.

When Should You Contact Engineering EDP Systems?

Whenever you have a need for: (1) an information system, (2) knowing what is available, and (3) where and how to get it. Proper contacts are given in the following paragraphs; the contact for the group is Group Manager, Ralph Byrd.

What Engineering EDP Systems Can Supply to You

Analysis and Reporting (Contact: Jeff Haber)
Provides the systems, tools, and information to the Engineering Management and Financial Staff.

Product Systems (Contact: Doug DeBarge)
Consists of two groups:

- Engineering Product Library System (EPLS) Support provides a central source of information about DIGITAL's products.
- Technical Editor and Configurator Development provides systems to: (1) edit orders in the field, and (2) support the configuration process in FA&T facilities.

Software Distribution Center Support (Contact: Jack Champney)
Devoted to providing and operating information systems in support of the Software Distribution Center business.

What Engineering EDP Systems Needs From You

Notification of your needs so they can direct you to the proper source.

3.24 ENGINEERING MODEL SHOP

The Engineering Model Shop is composed of four groups: (1) Mechanical Prototype Shop, (2) Prototype Shop, (3) Production Model Shop, and (4) the Engineering Stockroom.

The prime contacts are George Geralds, Manager, and Edith Bodwell, Production/Inventory Controller.

When Should You Contact the Engineering Model Shop?

Whenever you require their services in the following areas:

- Mechanical prototype
- Prototype assembly
- Production models
- Component Stockroom
- VCD (Variable Center Distance) insertion debug
- Insertion template debug
- ROM and PROM blasting
- Walk-in Shop
- Odd jobs

All work having a scheduled completion date should be negotiated in time to meet that schedule. Component requirements must be submitted to the Engineering Stockroom prior to submitting a circuit design to drafting. A legitimate engineering discrete project number is required for the current fiscal year.

Work is not prioritized; normal work flow is on a first-in, first-out basis. However, if the current workload in your job related area indicates that your schedule will not be met, you may consult with engineers who have requested work in the same area and negotiate an agreement to allow your work to be done first.

A month's notice is required for odd job requests and building testers since these requests are fulfilled when there are no models to be built.

What the Engineering Model Shop Can Supply to You

Mechanical Prototype Shop

- Fabricates sheet metal, plastic machined and wood units
- Provides Machine Shop services - milling, grinding, sawing, lathe work, heat treating, etc.
- Advise you as to what is feasible or difficult to manufacture.

Prototype Shop

- Assembles prototype modules, small subassemblies, wire-wrap, cable harnesses, etc.
- Checks for error in documentation, e.g., component part numbers.
- Producibility of units.

Production Model Shop

- Build printed circuit board (PCB) models for limited release (LR) and production release (PR) via the respective drafting satellite.

- Build subassembly models other than PCBs for LR and PR - power supplies, power controls, cable assemblies, etc.

- Generate hand testers as required for: (1) items that are not tested on automated module test (AMT) computerized module test (CMT) standard test equipment, or (2) for low volume items.

- VCD/IC debug of module insertion tapes via the respective drafting satellite.

- Perform odd jobs from building wire-wrap boards to show mockups, fill low volume customer orders, build cable harnesses, etc.

- Insertion template debug; checking steel templates fabricated for the insertion of components into board modules.

- Quality control checking of all models (LR and PR) and other items upon request.

- Blasting of PROMs to the electrical configuration as desired via tape, master chip, or keyboard, and stamping the number on the devices.

Maynard Engineering Stockroom
Stocks company-preferred components to avoid the design of obsolete or non-preferred parts into new units. (Another Engineering Stockroom exists in Marlboro.)

What the Engineering Model Shop Needs From You

Mechanical Prototype Shop

- Input information - can be sketches, blueprints, or verbal. The prototype process often takes several passes. Please don't order more units than you need for evaluation purposes.

- Prime Contact: Ed Mayall; in his absence, contact, Frank Boumil for machine parts, and Ralph Metivier for sheet metal and welding. They will process all necessary paperwork and notify you upon completion of your work.

Prototype Assembly Shop

- Requires proper documentation such as an overlay drawing or parts list and a schematic. The Prototype Shop works closely with Design Drafting. If you want a prototype from Design Drafting, they will forward the documentation to the Prototype Shop. You must ensure that Design Drafting and Prototype Assembly do not get out of phase when changes occur in the design. Procedures are informal so that changes may be incorporated easily which means that you must ensure that everyone concerned has the latest changes.

  Once a design is in Design Drafting, the Prototype Shop automatically makes a prototype. If you need special work done outside the Design Drafting loop, go to the Materials Controller, located in the Mill Complex ML5-3 (Pole 40A) and fill out a work order.

  This process also normally takes several passes. Please don't order more circuit boards than you need for evaluation until your design has stabilized.

Production Model Shop
For LR and PR of PCBs

- Contact relevant satellite drafting group or the ECO layout group.

- Then, work usually flows automatically to the Model Shop with the necessary documentation.

- You must sign the verification tag denoting test/tester availability on each model before release.

Formal Print Sign-off

- Handled by drafting satellite or ECO layout group.

- Required after quality control for LR and PR. (In the event that it is not QC approved, you will bear the cost of an ECO should one be necessary.)

Subassemblies - LR and PR

- Contact Model Shop Supervisor and provide formal or informal documentation to build from.
- You must sign verification tag denoting test/tester availability on each item released.

Formal Print Sign-off

- Required after quality control for LR and PR. (In the event that it is not QC approved, you will bear the cost of an ECO should one be necessary.)

Parts for LR and PR:

- You will save time if you supply new and/or unique parts at the time of release request.

For Hand Testers

- All that is needed is a schematic which may be formal or informal. Any critical areas such as short wire or shielded wires and any special notations must be included on the print.

Odd Jobs for Customers

- Jobs done for any DEC customer require formal documentation to build from and for quality checks if desired. For jobs other than DEC customers, any type documentation will suffice, provided it is legible and can be understood.

Stockroom
Component requirement for projects should be input early enough to compensate for the vendor's varying delivery schedules. A good rule of thumb is to submit your parts list to the stockroom just prior to submitting your new design to the drafting satellite.

The Stockroom will,
- Purchase components from the outside (with DEC part numbers).
- Expedite purchase of components from other stockrooms within DEC.
- Kit units in reasonable quantities.

References and Requisites That Help Make a Good Relationship

- Open communication between people involved
- Completed Work Order form
- Parts List
- Purchase Specification

3.25 COMPUTER AIDED DESIGN (CAD) SYSTEMS ENGINEERING
The CAD Systems Development group (Prime contact: Andy Matthews) is responsible for providing and supporting CAD tools which increase the integrity of DEC's designs and decrease the amount of time to first customer shipment of DEC's new products.

CAD Systems Development is organized into two major areas of technical expertise and a Product Management group. The two technical areas provide support of currently operating systems and software as well as development of new systems and enhancements. The Product Management group is responsible for coordinating all tasks and interfacing with customers (users).

MANAGER, CAD SYSTEMS ENGINEERING (ED VRABLIK)

- CAD PRODUCT MANAGEMENT (ANDY MATTHEWS)
  - P. C. TECHNOLOGY
  - TECHNICAL PLANNING
  - PROJECT PLANNING & CONTROL
  - RELEASE ENGINEERING & CONTROL
- CAD FOUNDATIONS DEVELOPMENT (LU ABEL)
  - DATA BASE
  - CAD OPERATING SYSTEMS
    - GRAPHICS SUBSYSTEM
    - WORK STATION DESIGN
- CAD APPLICATIONS DEVELOPMENT (BERT BRUCE)
  - PHYSICAL DESIGN APPLICATIONS
    - P. C. AND I. C. LAYOUT
    - WIREWRAP, ROMS, PROMS
  - LOGIC DESIGN APPLICATIONS
    - RTL LANGUAGES & SIMULATORS
    - LOGIC ENTRY/SCHEMATICS
  - DESIGN PROCESSING
    - ARTWORK, DESIGN VERIFICATION, PLOTTING, MANUFACTURING INTERFACE FILE/PRODUCT DESCRIPTION FILE DESIGN

MA-0505

When (Why) Should You Contact CAD Systems Development?

- If you are using CAD software and you find a problem. Documented problems get immediate attention.
- You see an area or process that you feel can be positively impacted by computer aided design.
- You are interested in investigating CAD related hardware/systems (plotters, vendor interactive systems, simulators, etc.).

What CAD Development Can do for You

- Provide consulting experts in most major areas of CAD/Computer Aided Manufacturing.
- Design/develop/support CAD applications new to DEC.
- Ease potential process problems in new or state-of-the-art development projects.

What CAD Development Needs From You

- Cooperation in communicating needs and ideas to this group.
- Some of your time to adequately define and implement new CAD tools.

3.26 INFORMATION PROCESSING SERVICES

Timesharing services to DIGITAL's internal users is provided by the Corporate Information Processing Center (IPC) group within the Information Processing Services organization. This service is available via large time-sharing systems located at Parker Street in Maynard with remote facilities throughout the various plants.

When Should You Contact IPC?

At any point in time in which you are involved in matters related to computer activities ranging from document generation to software program development.

What IPC Can Supply to You

- Timeshared services on the DECsystem-10 – Systems D and E are available for general usage Monday through Friday, from 7:45 a.m. to 5:30 a.m. of the next day; and on Saturday and Sunday, 24 hours a day.

- Public terminal areas are located in the "Mill" complex, buildings ML3-5 and ML21-4; at Parker Street, building PK3-1; in Marlboro, building MR2-3

- Remote Job Entry stations (RJEs) are available at the public terminal facilities listed above, providing convenient fast turnaround to the user of small to medium size listings. Listings may be printed at the main site; deliveries are made by IPC.

- All of the IPC Systems provide facilities that allow the user to establish a phone link with the required computer.

- Support for all standard DECsystem-10 software including:
  FORTRAN (Formula Translator)
  COBOL (Common Business Oriented Language)
  MACRO-10 (Assembly Language for the DEC-10)
  BASIC (Beginner All-purpose Symbolic Instruction Code)
  ALGOL (Algorithmetic Language)
  BLISS (Programming Language)
  MIMIC (a major simulation package)

- Software Preparation* puts handwritten material into machine-readable form, including:
  Editing for RUNOFF output (RUNOFF is a program that allows clean-looking print-outs of ASCII files.)
  Transcription
  Assembly/compilation.

*Software Preparation Services are provided by the Corporate Information Services Organization (CIS).

What IPC Needs From You

- Your project, programmer number (P,PN)
- Your password

You may obtain your P,PN and Password by contacting Customer Assistance (Prime Contact: Walter Broderick) and request an IPC Systems Access form.

Reference Material and Requisites That Help Make a Good Relationship
Customer Assistance is primarily a liaison between users and other groups within IPC, however, it is ready to respond to any questions or problems you may have regarding:

Systems Hardware or Software
System Policy
System Procedures

Customer Assistance also offers:

- Monthly seminars of an educational nature on topics of general interest to IPC's user community.

- Monthly publication of the IPC Newsletter.

DECsystem-10 manuals are available from the Software Distribution Center (SDC) in Maynard, ML11-3, to assist both the novice user and the experienced user.

3.27 COMPUTER SPECIAL SYSTEMS (CSS)
Computer Special Systems (CSS) is a Product Line chartered to make products to special customer requirements when there is no suitable DIGITAL standard product. CSS is also chartered to explore and open new markets and to provide low volume "gap filler" products. All this has to be achieved while making a profit and return on investment in line with DIGITAL's overall goals.

To this end, the Product Line has its own Marketing, Engineering, and Manufacturing organizations, for software as well as hardware. CSS has been structured so as to be very responsive to customer needs, as expressed through the DIGITAL Sales Force. To achieve this responsiveness, CSS is spread throughout the world. As well as having two engineering/manufacturing facilities in the United States, CSS has facilities in Canada, Australia, Japan, UK, France, Sweden, and Germany. Each facility has Marketing, Engineering, and Production staff, and is capable of designing and manufacturing products to special order.

ENGINEERING ENVIRONMENT
The Engineering environment, goals and responsibilities are different in CSS from those in Central Engineering. CSS projects vary from very small, to large and complex, and from essentially "standard" products, to tailored one-time systems, with special hardware and software.

CSS Products (Examples)

- Modification to a standard product, e.g., change to baud rate of a serial line driver
- TU45 magnetic tape system
- PDP-11 to CDC 7600 interface controller
- Analog and digital I/O equipment and systems
- Color, character/graphic displays, with supporting handlers and editing software
- Special character set terminals, e.g., Katakana and Kanji LA36 printers
- Multi-processor options, e.g., bus switches and line split adaptors

CSS also does fixed price turnkey projects in which special hardware and software is designed to fulfill a particular customer application. In order to ensure maximum effectiveness in this area, as in more traditional areas, CSS has developed a very strong Project Management capability. This has resulted in CSS being able to open new markets for DIGITAL products, and to successfully undertake many challenging tasks.

Technology in CSS
CSS is naturally dependent on technologies developed in Central Engineering, including LSI chips, new bus structures, interconnection methods, power supplies, etc. New technology is adopted rapidly in CSS; for example, a number of products incorporating microprocessors are being delivered to customers, and many others are in design.

CSS Mission/Engineer Challenge
The CSS mission of directly meeting special customer needs provides CSS engineers with a stimulating environment. The challenge of his task is to design and engineer new products to very short time scales (six months is typical) to meet project cost goals, and above all, to ensure that the customer is satisfied with the product, with CSS, and with DEC.

Who Should Contact CSS and When?
Mainly Sales people contact CSS when their customers have need of a special product or service. Product Line representatives also contact CSS when special market requirements arise, and, of course, there is frequent technical liaison between CSS and Central Engineering.

3.28 LABORATORY DATA PRODUCTS/MEDICAL PRODUCTS (LDP/MDP)

LDP's primary mission is to provide computer systems related software and supportive materials for research and scientific applications in:

- Educational and non-profit institutions
- Medical research
- Industrial
- Governmental institutions

MDP's responsibilities are for:

- All sales of specific products (e.g., GAMMA-11, a system used in nuclear medicine; PDL, a system used in clinical labs) to end-users or OEMs.

- All end-user sales into Medical Information Systems (MIS) applications

When Should You Contact LDP/MDP Product Line?
During a new product business planning stage at which time the LDP/MDP Product Line may indicate a high level of interest.

What LDP/MDP Can Supply to You

- Specifications, trade-offs, interfacing to other hardware, etc.
  Contacts:
  Hardware Development
    LDP/MDP - Bill Avery
    Graphics - Herve Lavoie

  Software Development
    LDP - Gary Budiansky
    MDP - Terry Weichmann

- Applications, market size, customer types, etc.
- Long range and high volume planning
- LDP and MDP inventory
- Members' names for Product Steering groups

What LDP/MDP Needs From You

- General product description and need
- Internal products impacted, and why
- Development costs and realistic schedule
- First Customer Ship (FCS) and volume schedule
- Major specifications with comparison to external competition

3.29 LARGE COMPUTER GROUP (LCG) HARDWARE ENGINEERING

LCG Hardware Engineering is a hardware development group, located in Marlboro, chartered to provide unit level components and systems integration support for the DECsystem-10 and -20 family of systems. These systems share a common 36-bit architecture which is optimized for medium to large scale interactive and time-sharing applications. The systems include PDP-11 front end processors with Unibus peripherals and Massbus interfaces, which facilitate the use of many unit level components developed by other groups. There are presently four Product Lines in Marlboro which market the DECsystem-10 and 20; LCG/Federal Systems, LCG/Commercial, LCG Educational Systems, and Scientific Systems.

LCG HARDWARE ENGINEERING (MANAGER, GEORGE HOFF)

- LCG/HE TECHNOLOGY (BILL WALTON)
  CIRCUITS ENGINEERING, MECHANICAL ENGINEERING,
  MEMORY DEVELOPMENT
- LCG/HE SYSTEMS ENGINEERING (VIC KU)
  MEDIUM TO LARGE SCALE CPU DESIGN, MICROPROGRAMMING AND
  SYSTEMS INTEGRATION AND ANALYSIS
- LCG/HE PERIPHERALS/COMMUNICATIONS (FRANCO PREVID)
  CONTROLLER DESIGN AND PERIPHERAL DEVICE INTEGRATION FOR TAPE,
  DISK, UNIT RECORD AND COMMUNICATIONS SUBSYSTEMS
- LCG/HE CURRENT PRODUCT ENG./ENG. SUPPORT (LEN KREIDERMACHER)
  SUPPORT TO RELEASED PRODUCTS. DEVELOPMENT SUPPORT-DESIGN
  PROCESSING, PROTOTYPE FABRICATION AND ECO PROCESSING

MA-0511

LCG/Hardware Engineering Specialized Expertise

- CPU/Memory/Channel/Architecture/Design Evaluation/Performance Analysis and Development

- High Performance Technology - ECL, 16K MOS, Gate Arrays, RAMs, High Speed Interconnect, Power Analysis

- Design Aids - Logic Design Support Systems (Stanford Drawing System), Delay Analysis, Simulation (Logic and Microcode), Design Checking

- High Performance Peripheral Device Evaluation 200 ips Tape, High Technology Disk

- Hardware/Software Tradeoff Analysis, Multi-processing Architecture, Integrated Facilities for On-line Diagnostic and Cache/Control Store Design

- System Integration and Performance Analysis for Large Complex Systems

- Communications Networking

NOTE

The capabilities available in LCG/Hardware Engineering should be viewed as an extension of Maynard Central Engineering, and as such should be considered applicable to the needs of any Product Line within DIGITAL.

3.30 FEDERAL SYSTEMS GROUP (FSG) HARDWARE ENGINEERING

The Federal Systems Group is one of four Product Lines within the Large Computer Group (LCG) organization. FSG is chartered to sell to the United States and foreign agencies and to Aerospace OEMs. FSG Engineering services the needs peculiar to the FSG Product Line and provides unit level components and systems integration support.

FSG, Hardware Engineering Specialized Expertise

- Computer Networking, including ARPANET
- Computer - Computer Communication
- High Availability Systems
- Complex Systems

FSG Engineering also provides consulting services on new products that will be useful to the Federal Systems Product Line. (Contact: Steve Paavola.)

3.31 OEM AND PDP-8

The corporation relies on its OEM channel of distribution to sell most DIGITAL products indirectly for use in any application. OEM's primary mission is to serve as a channel of distribution to the resale class of customers; to develop segments of the growing minicomputer market, entailing nominal front-end expenditures in marketing, service, and software; to answer competitive challenges by offering goods and services at the lowest possible price available from DIGITAL.

PDP-8's primary mission is to provide PDP-8 systems and options in both the OEM and end-user marketplaces. Prime focus is in OEM, Industrial and Lab markets, primarily as a "tools" supplier in the small systems and basic mainframe areas.

Products and Services Sold

OEM

- The entire family of PDP-11 and PDP-8 processors
- All associated non-unique peripherals and options
- All PDP-11 and PDP-8 software not classified as a unique product

PDP-8

- All Omnibus PDP-8 processors, associated peripherals, options and software, as defined by the market charter

- VT78 DECstation

Engineering Interface

Engineering contact with the OEM and PDP-8 organization is usually accomplished through the Engineer's Product Manager. (A Group Organization Chart provided in Appendix A.)

Rationale

OEM

Primarily to minimize the problem of managing competition between DIGITAL and its resale customers, DIGITAL has decided to maintain independence between the OEM and end-user sides of its business. At the same time, the Marketing Committee recognizes the need to make exceptions, if necessary, to accommodate truly unique market needs. To ensure that charter boundaries are well defined, all proposed exceptions to the general OEM rule must be formally brought before the Marketing Committee for approval.

PDP-8

A consolidated Product Line organized on a product basis selling to both end-users and OEMS.

3.32 INDUSTRIAL PRODUCTS GROUP (IPG) - (Engineering Manager, Bob Savell)

IPG provides computer systems and unique products for process and manufacturing control to end-user industrial customers involved in extraction of raw materials, manufacture of products, and storage and distribution.

IPG usually deals in low volume (100 to 1000) standard Product Line hardware and software (handlers to interface IPG products to DIGITAL standard PDP-11 Operating Systems such as RSX-11 and TPS) products relevant to what is needed by the market it serves.

A project-oriented organization, IPG makes early contact with the service groups within DIGITAL and provides them with funding and project scheduling to ensure the meeting of First Customer Ship (FCS) target dates.

IPG Products

- Industrial 14
- Factory Data Collection Terminals
- Factory Data Collection Software
- Process I/O Subsystem
- Intelligent Process I/O Subsystem
- Power Management

3.33 EDUCATION PRODUCTS GROUP (EPG) - (Manager, Jerry Witmore)

The Education Products Group provides PDP-11 based systems to public and private educational institutions and training departments within industrial organizations in support of their educational or administrative activities. While some effort is underway to enhance DIGITAL's education-specific product offerings, the bulk of customer requirements are satisfied by standard hardware and software products, especially in the time-sharing area. Because of the general computational nature of the EPG market, much of the engineering investment by the Product Line is in the packaging of standard products into often-demanded user configurations in order to facilitate Marketing, Sales, and Manufacturing. In addition, there is investment in software to support various aspects of educational administration, as well as in human engineering refinement of standard software products.

EPG Products

- CLASSIC, WISE, SIGI, DECAL (Product Line unique products)

3.34 CORPORATE SOFTWARE SERVICES

Corporate Software Services' goal is to satisfy DIGITAL customers' software services needs. The organization's objectives are to deliver software services that help sell standard products in accordance with the following priorities:

- Warranty
- Sales Support
- Consulting

and to deliver software services that help implement Product Lines' marketing plans and corporate policies.

CORPORATE SOFTWARE SERVICES

- FIELD ORGANIZATION
  - NORTH AMERICAN, EUROPEAN, GENERAL INTERNATIONAL AREA (GIA)
- OPERATIONS
  - CORPORATE OPERATIONS GROUP
- INCOME SERVICES
  - SOFTWARE SERVICES PRODUCT LINES (PL-90 FAMILY)

MA-0510

Field Software Services

In the field, Software Services provides:

- Warranty Support – The warranty support function varies depending on the category of software product, as follows.

  Category A

  Installation of the software and execution of a sample procedure to ensure successful completion.

  On site remedial service for the first 90 days after installation if required. This is a best effort to fix the software problem and/or submit a Software Performance Report (SPR) concerning the problem.

  Categories A and B

  SPR services are provided for a term of one year from date of installation. This includes the right of the customer to submit SPRs when a software deficit is believed to exist. DIGITAL will respond via the software maintenance periodicals.

  Provide software updates, if any, on standard distribution media as defined in the applicable Software Product Description (SPD). Only the media will be charged for in the first year from date of installation.

  All other categories are delivered as is with no specified or implied warranty commitment.

- Sales Support – These services are requested by the Sales organization to assist the Sales person in selling standard DIGITAL products and services.
  Demonstrations of a DIGITAL system
  Technical presentations
  System design/recommendation
  Benchmarks
  Proposal assistance
  Informal discussions with sales/customers
  Technical consultant to sales/customers

- Consulting Services – These services are designed to help sell standard DIGITAL products. They are normally provided when customer needs (expectations) exceed the services provided through the normal warranty and Sales Support efforts. They are paid for directly by the customers and may be bundled into the system's price when agreed to in advance between Product Lines. Typical functions include:

  Program conversions
  Software/system design
  Project management
  Programming (coding and checkout)
  Studies
  Specification design
  Applications
  Advisory – problem solving
  Software implementation
  Extended warranty/maintenance services
  Orientation services
  Additional services as approved by the Software Services Manager or his designee

- Allowances – These services are designed to allow Product Lines to request "extra" software support to meet their marketing objectives; services not normally covered by those described above. They are normally negotiated for in advance and budgeted for under the service expense line of the Product Line statement. Typical services include:

  Extra support services to a specific customer base or geographic area.
  Internal training
  QA for Product Lines/Engineering
  Special demonstrations/benchmarks
  Services provided in "Sales Support" and "Consulting Services" when negotiated and agreed to by the Software Services Manager or his designee.

Operations Group
Provides corporate-based resources to meet acknowledged needs of Software Services Line Management.

OPERATIONS GROUP (HASKELL CEHRS)

- MAYNARD SUPPORT GROUP (HENRY ADLEMAN)
- MARLBORO SUPPORT GROUP (CLARKE WEGNER)
- SOFTWARE SERVICES TRAINING GROUP (NICK PAPPAS)
- ADMINISTRATIVE SERVICES GROUP (ANGELA COSSETTE)
- MANAGEMENT INFORMATION SYSTEMS GROUP (MAUREEN STRETCH)

MA-0508

- Maynard/Marlboro Support Groups
  *Support planning
  *Product planning documents
  *Support tool development, i.e., manuals, buffer articles, Sales Update articles
  Documentation review
  Time Reporting Systems (TRS) analysis
  Software Performance Report (SPR) analysis
  Manpower planning/forecasting/reporting
  Backup technical support to field SWS
  Technical in-field training
  On-site support (at field request)
  Field Service support
  Software Performance Report fixes (Marlboro/LCG)
  Maintenance updates
  *Time Reporting Systems reporting
  *Product Steering Group interaction
  *Interface with product management
  *Interface with Engineering
  *Interface with Product Lines
  *Training planning
  *Training documentation
  *Training material review
  Field test, coordination, information, and materials

*Tasks are also applicable to Sales Support, consulting, and by prior negotiation allowance categories.

- Software Services Training provides:
  A curriculum of standard courses for Software Specialists on DIGITAL software products.

  Update courses for new releases of software products.

  Advice to Field Software Services (SWS) Management on training personnel whose needs are not met by the Standard SWS training curriculum

- Administrative Services Group
  Software Product Description (SPD) administration

  Software Performance Report administration and reporting

  Warranty Data Base administration

  Automatic Distribution (software) administration

  Preparation and distribution of Software Dispatches and DSNs (DIGITAL Software News)

  Preparation and distribution of small and large buffers

- Management Information Systems group provides internal EDP packages for:
  District SWS Accounting
  Customer Data Base
  Software Shipment/Man days
  Time Reporting System
  Automatic Distribution System
  Mailing Label System

Consulting Services (Software Services Product Lines)
The Software Services Product Lines' primary business is selling software-related services to DIGITAL customers. These services are beyond and apart from those included as part of the warranty for most DIGITAL software products.

PL90 Software Consulting Services:
The sale of DIGITAL Software Specialists expertise on a time and materials basis.

PL91 Software Maintenance Services:
The sale of binary updates and packaged software information via Subscription Software Maintenance.

PL86 Software Components:
The sale of documents, listings and programs, exclusive and separate from the original software kits.

PL85 Software Products:
The sale of software products developed via PL90 Software Consulting Projects.

When Should You Contact Software Services?
Whenever you have a need for their services as described in the foregoing paragraphs.

What Software Services Can Provide to You
Expertise and consultation in Field Support, Operations, Administration, Management Information Services, and Training.

References

- Software Specialists Handbook – available from the Corporate Software Services Organization, Manager Bruno Durr.

- Software Services Training Directory – available from the Software Services Training Organization, Manager Nick Pappas.

3.35 CUSTOMER SERVICES

The areas of responsibility within the Customer Services groups during the design, manufacture, and field introduction of new products are described in the following paragraphs. A team concept was devised by evaluating the functions of each group during new product development and establishing its relationship with other groups as indicated in the diagram shown on the next page.

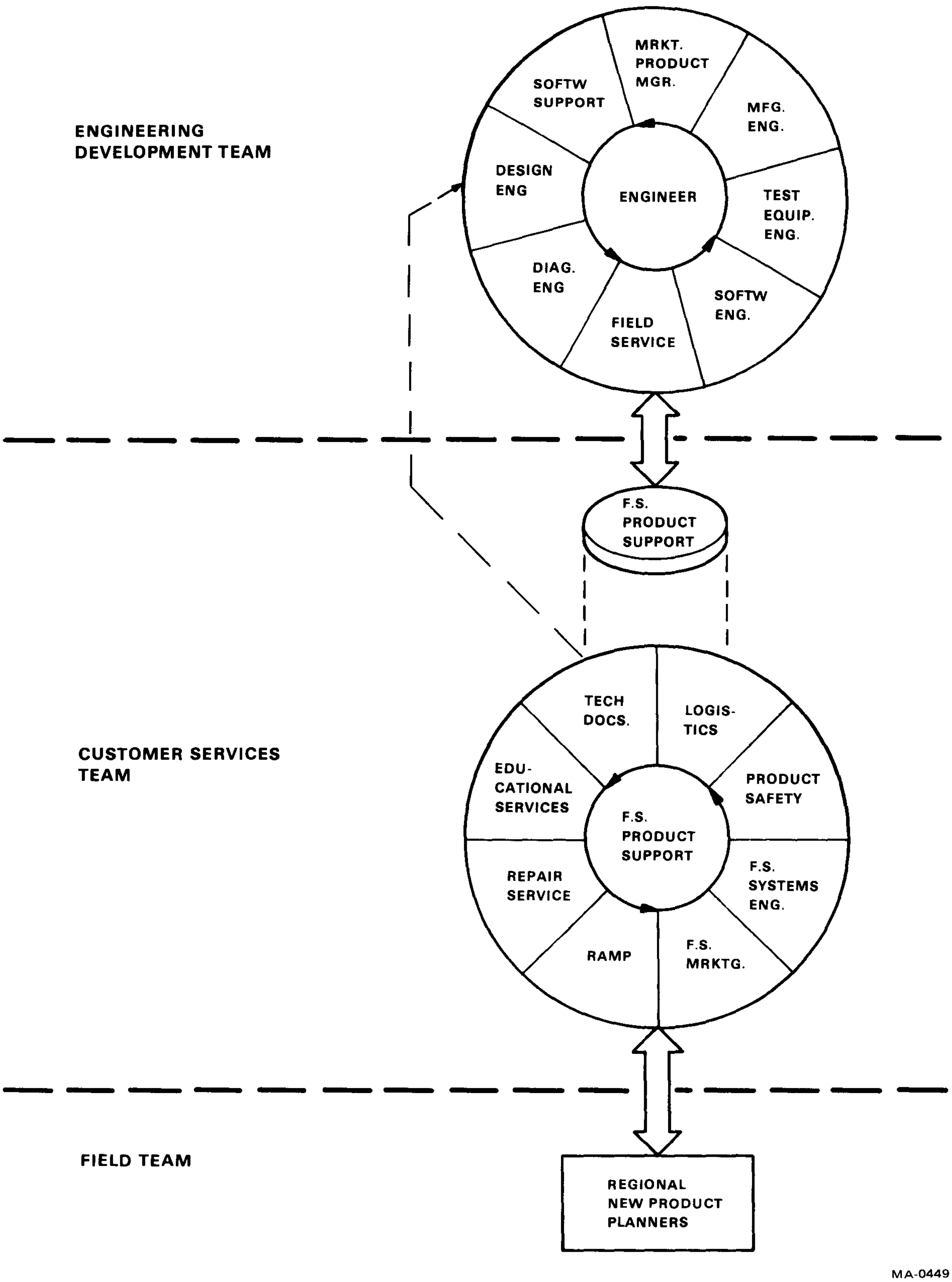
When Should You Contact Customer Services?
During the planning process stage for efficient interaction of the new product development groups. Contact should be made with Customer Services through the Product Support groups assigned to your engineering area. Contact should be made as early as possible when product proposals and Phase I Business Plans are being developed. Product Support can provide financial and technical inputs during this initial planning phase which will help to add completeness to the Business Plan and avoid surprises after major product goals have been set.

What Customer Services Can Supply to You
The Field Service Product Support Supervisor or Engineer coordinates the activities of the Customer Services groups and the interfacing with the Development and Field groups to provide maintenance plans and schedules. He is assigned to the project during the initial planning/design stage and receives the necessary inputs (specifications, schedules, and estimates) from which he generates Maintenance Plans, Field Service Business Plans, Cost/Benefit studies, and schedules for coordinating the Customer Services activities.

The Customer Services team is composed of the following groups:

- Logistics
- RAMP (Reliability and Maintainability Program)
- Technical Documentation
- Educational Services/Field Service
- Repair Services
- Field Service Marketing
- Product Safety
- Field Service Systems Engineering

These groups are responsible for influencing the product design and manufacture to facilitate field maintenance of the new product, ensuring that both training and field documentation conform with the Maintenance Plan, and coordinating a smooth introduction of the product into the field.


ENGINEERING DEVELOPMENT TEAM
SOFTW SUPPORT
MRKT. PRODUCT MGR.
MFG. ENG.
DESIGN ENG
ENGINEER
TEST EQUIP. ENG.
DIAG. ENG
SOFTW ENG.
FIELD SERVICE
F.S. PRODUCT SUPPORT
CUSTOMER SERVICES TEAM
TECH DOCS.
LOGIS-TICS
EDU-CATIONAL SERVICES
PRODUCT SAFETY
F.S. PRODUCT SUPPORT
REPAIR SERVICE
F.S. SYSTEMS ENG.
RAMP
F.S. MRKTG.
FIELD TEAM
REGIONAL NEW PRODUCT PLANNERS
MA-0449

Product Support (Don Busiek)
Product Support is responsible for the efforts provided by the Customer Services team. In this role, Product Support will develop the Field Service Maintenance and Business Plans as well as the Project Schedule. The following is a list of the various Product Support groups and their area of responsibility:

Chris Ball
- Cross-Product Line (CPL) - Tapes, Disks, Terminals
- Power Systems
- Mechanical/Packaging
- LSI Technology
- Product Safety

Steve Davis
- Operations Research

Mike Kalagher
- DIGITAL Components Group (DCG)
- Distributed Data Processing (DDP)
- Laboratory Data Products (LDP)
- Networks
- BUS Products
- TELCO
- CSS/Typeset
- Installations Quality Reporting
- OEM
- Engineering Systems Group (ESG)
- Educational Products Group (EPG)

Walter Manter
- DEC-10, -20

Bob Swarz
- Reliability and Maintainability Program (RAMP)

Art Zins
- PDP-8, -11, Advanced-11 Family
- Memories
- -11, Advanced-11 Family Software

Technical Documentation (Joe Santini)
Generates hardware documents required to support the training functions and field maintenance for the new product. (Detailed description provided in another section of this chapter.)

Educational Services/Field Service (Mike Moffa)
Determines the Field Service training requirements and develops course materials and aids to be used by the Educational Services Training Operations to teach Field Service personnel and some customers the operation and maintenance of new products.

Product Safety (Ron Minezzi)
All hardware products must meet the requirements of DEC Standards 060, DIGITAL Policy Relating to Nationally and Internationally Recognized Testing Laboratories, and 119, DIGITAL Policy and Practices Relative to Product Safety. All applicable products must be UL Listed, Canadian Standards Association (CSA) Certified and comply with International Electrotechnical Commission (IEC) 435.

Listings and Certifications are always obtained through the Product Safety group. You should subject your product to Product Safety reviews at the conceptual, breadboard, and prototype stages. A second function of the Product Safety group is to investigate all potential product safety problems. You are required to support all such investigations regarding your product until all problems are resolved.

Field Service Marketing (Doug Largenberg)
Determines the structure of the maintenance agreements and establishes maintenance contract terms, prices, and conditions for the new product.

Repair Services (Harold Long)
Restores the operation of defective modules and products that cannot be effectively repaired at the customer site.

Logistics (Tom Karpowski)
Forecasts, procures, distributes, and prices spare parts and special tools to support Field Service maintenance of new product.

RAMP (Reliability and Maintainability Program) (Bob Swarz)
Provides models and metrics that can be used with Field Service data base to determine reliability and maintainability characteristics of existing products. (Detailed description provided in another section of this chapter.)

Field Service Systems Engineering (Scott Johnson)
Provides system focus for maintainability planning on PDP-8, -11 and Advanced-11 family products. Provides interface into Software Engineering for error logging, software installations, etc., and to Diagnostic Engineering for system exercisers, and user-mode diagnostics, etc.

What Customer Services Needs From You
Your cooperation in the performance of your responsibilities governed by:

DEC Standard 007, Design Review Process
DEC Standard 008, Project Scheduling
DEC Standard 009, Project Specifications
DEC Standard 130, Product Business Plans

which define the procedures required to obtain new product approval, the formats of the hardware and software specifications, the *Engineering Tasks* to be performed during specific project phases and the type of schedules and cost estimates to be provided by Engineering and Manufacturing.

Reference Material and Requisites That Help Make a Good Relationship
The Customer Services Guide to New Product Planning – Generated by the Field Service New Product Steering group.

3.35.1 Reliability and Maintainability Program (RAMP) (Prime Contact: Bob Swarz)
The RAMP group provides models and metrics that can be used with the Field Service data base to determine reliability and maintainability characteristics of existing products. Other models can be used with projected data to support new product development.

When Should You Contact the RAMP Group?
In the conceptual stages of product planning. It is imperative that reliability and maintainability issues be an integral part of the design.

What RAMP Can Supply to You

- Publish periodic MTBF and MTTR reports on selected existing products
- Provide models and other tools that assist in examining the cost and benefits of reliability and maintainability features
- Provide life cycle cost models
- Provide statistical models of product failure rates to support early product reliability prediction needs
- Provide information on current and future reliability and maintainability strategies and technologies
- Provide a unified corporate approach to reliability and maintainability.

What RAMP Needs From You

- Early contact
- Preliminary engineering specifications and initial design concepts
- High level of interest in total life cycle cost

3.35.2 Technical Documentation

Technical Writing (Prime Contact: Jack Cromwell)
The Technical Writing group is responsible for providing all hardware manuals intended for Field Service use. The group is also responsible for providing hardware manuals for target populations other than DEC Field Service. Technical Writing consists of the following dedicated areas.

MANAGER TECHNICAL WRITING (JACK CROMWELL)

- MARLBORO WRITING GROUP (DON MEHAFFEY)
  - LARGE COMPUTER GROUP (GEORGE BERGER)
  - LABORATORY DATA PRODUCTS (LDP)
  - LARGE SCALE INTEGRATION (LSI)
  - GRAPHICS
  - COMPONENTS
  - LOGIC PRODUCTS
- MAYNARD WRITING GROUPS
  - PERIPHERALS (JIM SULLIVAN)
  - PDP-8 – PDP-11 (ROY CLARK)
  - PRODUCT SUPPORT – BUSINESS PRODUCTS – INDUSTRIAL PRODUCTS (JOHN SULLIVAN)
- NEW HAMPSHIRE WRITING GROUP (HUDSON, LEE BUTLER)
  - COMMERCIAL APPLICATIONS
  - TELCO

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When Should You Contact Technical Writing?

- During the project planning stage when the tasks that will occur within the development cycle can be specified.
- Technical Writing usually receives notification of the need of their services via the Product Support group prior to any formal periodic budgeting activity with regard to current project costs and schedules.

What Technical Writing Can Supply to You

- Writing and control of hardware-oriented technical documents in accordance with DEC Standard 003.
- Total publications plans, cost estimates, and schedules necessary to assign engineering funds to the documentation effort.
- One source to fund for writing and production of hardware manuals
- Coordination of printing, production, and revision control of the following types of documents:
  - Site Preparation Guides
  - Installation Procedures
  - Hardware Reference Manuals
  - User's Guides
  - Preventative Maintenance Procedures
  - Servicing Manuals
  - Illustrated Parts Breakdown Manuals
  - Field Maintenance Technical Manuals
  - Application User's Manuals
  - Others, as specified

What Technical Writing Needs From You

- Cooperation in generating a documentation plan acceptable to Product Support, Technical Documentation, Engineering, and Educational Services. The documentation plan indicates the scope of the hardware manual project, schedule requirements, and the approved budget for the project.
- Engineering drawings, equipment specifications, and any other technical information available.
- Some engineering time for technical information and manuscript reviews.

Reference Material and Requisites That Help Make a Good Relationship

- DEC Standard 003, Hardware Manuals Standard
- Field Service New Product Planning Guide (prepared by Customer Service Product Support)
- Field Service Methods and Procedures
- Documentation Plan
- Scheduled Document Reviews
- Engineering time; direct interaction between you and the writer

Micropublishing Documentation (Dick Lennard)
The Micropublishing Documentation group provides the generation, control and distribution of microfiche for Field Service and Customer Spares microfiche libraries, as well as Manufacturing libraries and casual orders. They also provide FCO (Field Change Order) generation and writing and control of DEC-O-LOG and FCO Cross-Reference documentation systems. This group designs microfiche formats and libraries to support Field Service in installing, updating, and maintaining DIGITAL products. They also monitor schedules and activities of information-producing areas such

as Technical Writing, Diagnostic Engineering, Engineering, etc., and coordinate efforts to ensure proper integration of source information in microfiche preparation and production.

This group is responsible for:

- Budgeting, planning, and scheduling production of all documentation requested by DEC groups.
- Creative consultation for design of books, charts, etc.
- Providing all required photographic services.
- Evaluating machinery and equipment being developed for the publishing industry regarding their utility in DEC.
- Developing methods and procedures to enhance DEC documentation at the lowest cost.

MANAGER PRODUCTION SERVICES (WALTER STALTER)

- EDITING AND COMPOSITION (PHIL KELLEY)
  - EDITORIAL SERVICES
  - BOOK-PAGE MAKEUP
  - COMPUTERIZED TYPESETTING (DECSET-8000)
- ILLUSTRATING (BOB WALKER)
  - CHARTS, DIAGRAMS, SCHEMATICS, 3-DIMENSIONAL
  - COLOR SLIDES, VU-GRAPHS (OVERHEADS), FLIPCHARTS
  - STORYBOARDING, CONCEPTS, CARTOONING, RENDERINGS, RETOUCHING
- PHOTOGRAPHY (LEE PARKS)
  - PHOTOSTATS - NEGATIVE AND POSITIVE
  - 8 X 10 TRANSPARENCIES FOR OVERHEAD PROJECTION
  - NEGATIVES FOR OFFSET PRINTING
  - PHOTOGRAPHY – STUDIO OR ON-SITE
  - SLIDES – DUPLICATION, OR FROM ANY ORIGINAL
  - REPOSITORY OF WORLDWIDE PHOTOGRAPHS

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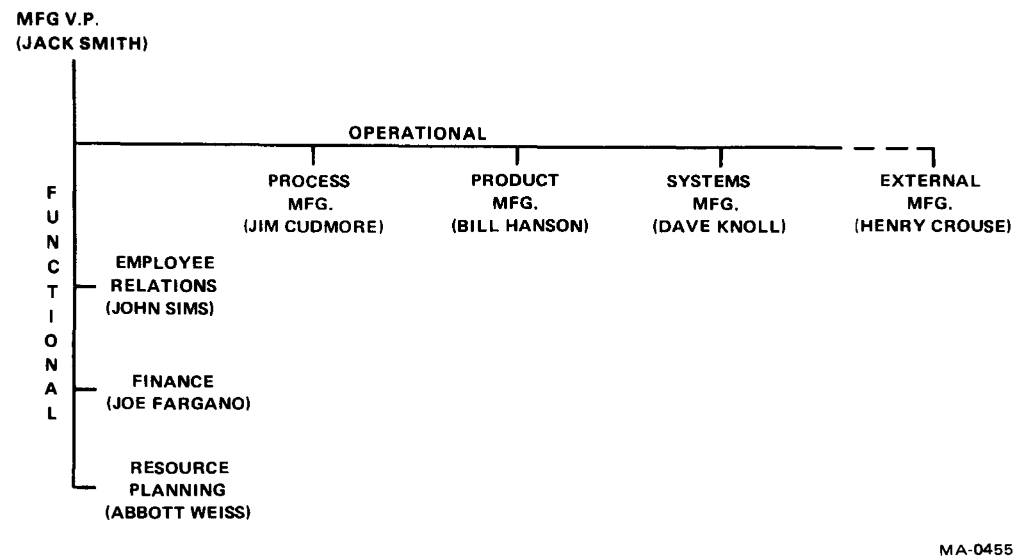
Editing and Composition – Performs editing, formatting, typesetting, scheduling, coordinating, and contracting of the foregoing services with outside vendors when necessary. The typesetting group utilizes a DECset-8000 typesetting system for producing copy for publication.

Illustrating – Provides technical illustrating, 35mm slides and overhead transparencies illustrating graphic art expertise to enhance all documentation required by DEC groups.

Photography – The Photographic Laboratory supports the Technical Documentation Department and all DEC groups in providing complete color and black and white photographic and graphic arts services.

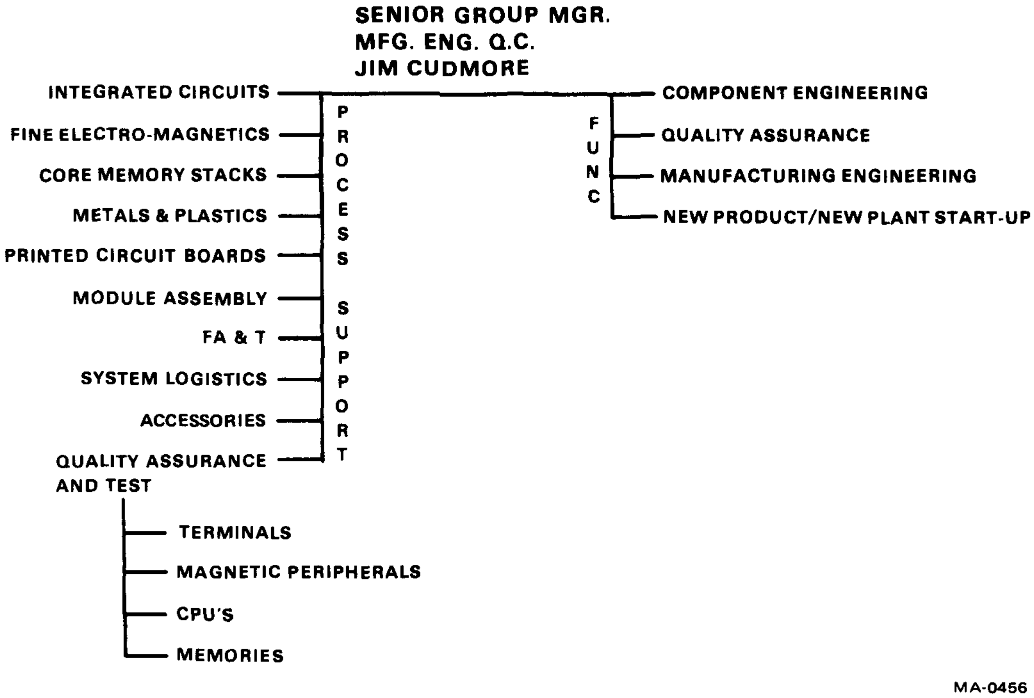
3.36 MANUFACTURING

The Manufacturing organization is better represented in a matrix as shown below. Relevant operational and functional groups are described in this section. The groups' functions and the communication required between you and the individuals within these groups will help you identify your partner for the two-by-two team effort in developing your product.



3.36.1 Manufacturing Engineering and Quality Control

Jim Cudmore is the Senior Group Manager of Manufacturing Engineering and Quality Control. This organization comprises both functional and process support groups as shown in the following chart.



The *Manufacturing Engineering Organization Directory* is published quarterly. It provides the names of individuals responsible for various areas. Contact Marie Mangan, Ext: 5328 for a copy.

3.36.1.1 Printed Circuit Board Process (Prime Contact: Don Pucci) - PCB Process Manufacturing Engineering provides advice and direction setting to Manufacturing, Design Engineering, and the Board Shops. They oversee the entire board manufacturing process and:

- Develop five year capacity and technology planning
- Determine when to build new Board Shops
- Develop board purchasing strategy
- Determine impact of new environmental rules on manufacturing.

When Should You Contact PCB Process Engineering?
If a new packaging scheme is to be used, at least before the electronics fabrication scheme is frozen. If you need dedicated help, they need a three-month advance notice.

What PCB Process Engineering Can Supply to You

- How new boards should be designed to make them manufacturable in all DEC plants
- Help you understand the benefits of design constraints imposed by high-volume manufacturing
- Lower manufacturing costs through automated manufacturing which requires standard
  - board sizes
  - machine insertable components
  - pin spacing, and
  - component spacing
- Explain how DEC manufactures PCBs

What PCB Process Engineering Needs From You

- Your presence to develop effective communication between you and your contact
- Lead time and funding if you need one of their people to be dedicated to your project
- Your appreciation of the fact that the deletion of a requirement or a painful restriction in the manufacture of your product will cause a savings that repeats itself thousands of times each month

Reference Material and Requisites That Help Make a Good Relationship

- DEC Standard 030, Module Manufacturing Specification
- Non-standard Board Release Form; described in DEC Standard 030. You must obtain manufacturing approval whenever you use a non-standard component, pin spacing, or board size (via this form).

NOTE

PCB Process Engineering recommends that you tour DEC's manufacturing facilities and become acquainted with the different high-volume manufacturing processes.

3.36.1.2 Corporate Quality Assurance (Manager, Gene Mondani) – The Corporate Quality Assurance organization exists to provide assurance to DIGITAL customers that our products meet specifications and reasonable customer expectations on a continuing basis. The organization consists of two groups:

- *Corporate Reliability Engineering* – Manager, Art Sturgis. This is the group to which you, the engineer, will relate. It is described in detail below.
- *Corporate Quality Services* – Manager, Darby Checketts. This group supports the varied, quality-related activities of Manufacturing, Marketing, and Field Service.

Corporate Reliability Engineering
Assures a low risk, economical product to high volume manufacturing. Normally, this is accomplished through Design Maturity Testing (DMT) which is performed in the Reliability Engineering Labs.

What Corporate Reliability Engineering Can Supply to You
Engineering prototypes and/or initial manufacturing pilot units are submitted to Reliability Engineering for independent third party evaluation. Through a Review Action Team (RAT) with members representing Design Engineering, Reliability Engineering, and Manufacturing, a detailed plan is determined with MTBF goals specified. ECO activity will decrease to the point where Manufacturing startup is feasible and DMT will progress to the point where the necessary ECOs have been *incorporated* to meet the specified MTBF goals.

When Should You Contact Corporate Reliability Engineering?
After Office of Development (OOD) approval of your functional specifications. Initial inputs should include engineering MTBF (Mean Time Between Failure) goals.

What Corporate Reliability Engineering Needs From You
All that's required is that you contact Reliability Engineering Manager, Art Sturgis (Ext. 4979) who will assign a Central Reliability Engineer to chair the Review Action Team and issue the DMT plan.

REFERENCES

- Product Reliability and Process Testing Manual, prepared by Central Reliability Engineering.
- DEC Standard 102, Environmental Standard for Computers and Peripherals.

3.36.1.3 Process Engineering – Process Engineering comprises five groups, each capable of addressing the assembly and test processes in detail. The Advanced Process Engineering group addresses the wire-wrap process and new technologies in component incoming inspection, printed circuit board assembly, and printed circuit board test areas. The groups and the responsible people to contact are listed below.

- Advanced Process Engineering (Jim Melvin)
- CPU Process Engineering (Art Berner)
- Disk/Tapes Process Engineering (Joe Cleary)
- Terminals Process Engineering (Bruce Anderson)
- Cross Products Process Engineering; encompassing Communications, Controllers, etc. (Bob Difazio, Acting)

When Should You Contact Process Engineering?
Before the electronic design is frozen. If you want dedicated help, they need three months warning.

What Process Engineering Can Supply to You

NOTE

PCB Process Engineering (described in an earlier paragraph) addresses the manufacturing process of the bare printed circuit board. Process Engineering addresses the manufacturing and test process related to the populated modules and assemblies.

Process Engineering supplies information about manufacturing and testing. They will help you make financial and technical trade-offs on:

- Component Testing
- Circuit Boards

- Modules
- Interconnection Systems
- Cable Harnesses
- Wiring
- Wire-wrap
- Basic Systems

They also provide counsel on testing at the basic system, module, and incoming levels.

They will help you to understand the benefits of design constraints imposed by high-volume manufacturing. If you want lower manufacturing costs through automated manufacturing, you need standard board sizes, machine-insertable components, standard pin spacings, component spacings, test techniques, etc. They will suggest things like using two 1/2-watt resistors in parallel instead of a single 1-watt resistor, because the 1/2-watt resistors are machine-insertable, while generally, 1-watt resistors are not. They will advise you on the implications of DEC Standard 030, Module Manufacturing Specification, for your product.

They will explain how DIGITAL manufactures things. They recommend that every engineer tour our manufacturing facilities, and that every design engineer consult with them before the electronic design and fabrication is frozen. They are always available for a few hours consultation. In some cases, they will dedicate an engineer to your problem or project, provided you set it up in advance and provide the funds.

Process Engineering is charged with overseeing the entire manufacturing process. In this role they:

- Improve efficiency in today's world. This sometimes involves making changes in the manufacturing process for current products. When a change affects the final product, they always obtain the approval of the project engineer. When it doesn't (for example, when they change from punch to slit), they do not seek engineering approval.

- Plan for new facilities and manufacturing methods that will be cost competitive in the future.

What Process Engineering Needs From You
They need your presence for consultation. They need lead time and funds if you need dedicated help from one of their people. They need you to appreciate the fact that sometimes a seemingly painful restriction or requirement will cause a manufacturing saving that repeats itself thousands of times each month. Be sure to ask process engineers about the different high-volume manufacturing facilities.

Reference Material and Requisites That Help Make a Good Relationship

- DEC Standard 030, Module Manufacturing Specification
- Non-standard Board Release Form. This is required whenever you use a non-standard component, pin spacing, or board size. You must obtain manufacturing approval via this form

What Process Engineering Can Supply You for Testing

- A test plan developed by the New Product Strategist
- Direction in how to partition for testability and diagonosability
- Screening to stop untestable or unmanufacturable products from going to manufacturing
- They will participate in Design Reviews.

What Process Engineering Needs From You for Testing

- Funding to support an agreed upon level of test engineering participation
- Product Specification
- Product Performance Specification
- The latest module, unit, or system drawings (depending on what is to be tested)
- Goals for product volume (top and bottom figures)
- Engineer's estimates of manufacturing cost.
- Attendance at monthly Test Engineering Status Reviews to assure project coordination

References and Requisites That Help Make a Good Relationship

- Product Specification
- Product Performance Specification
- Test Plan

3.36.1.4 Manufacturing New Product Introduction – Manufacturing has a New Product Introduction organization. This organization is responsible for:

- Coordinating Manufacturing's overall capabilities and strategies with DIGITAL's projected future products

- Coordinating the Manufacturing aspect of each new product with Engineering and other company organizations prior to actual manufacture of the product.

- Managing the introduction of each new product into Manufacturing.

When Should You Contact Manufacturing New Products?
If you are planning, or even considering a new product to go into manufacture, contact Manufacturing New Products *NOW!*

Look at the chart on the next page. It is the basic skeleton of a new product's introduction into Manufacturing.

Manufacturing must make inputs *before* the Phase I Business Plan is written. In order to do this, Manufacturing and Engineering must communicate with each other early in the new product's development. We call this working together "Before the Beginning." It plays a very important part in our mutual goal of introducing DIGITAL's new products on schedule, at quality, at cost, to budget.

CHART I: GENERAL NEW PRODUCT START-UP PLAN

MAJOR EVENT → PURPOSE OF EVENT → TASKS REQUIRED FOR EVENT TO OCCUR

1 — IDEA PRELIMINARY APPROVAL GIVEN BY THE OFFICE OF DEVELOPMENT

PURPOSE OF EVENT: To develop profitable new products for Digital.

TASKS REQUIRED FOR EVENT TO OCCUR:
1. Two page preliminary business plan written.
2. Preliminary business plan approved by OOD.
RE: Corporate Policy Memo 75-8.

12 — PHASE I BUSINESS PLAN APPROVED BY OFFICE OF DEVELOPMENT

PURPOSE OF EVENT: To receive authorization for funding & other resources to complete product design, and to put in place other necessary product plans.

TASKS REQUIRED FOR EVENT TO OCCUR:
1. Customer need defined.
2. Solution defined in form of product.
3. Proposed product passed Design Review DEC STD 007.
4. Market projection evaluated as favorable & initial sales projections made.
5. Market strategy defined & approved to fit with overall strategy by the Product Line Managers.
6. Manufacturing capability/strategy reviewed & approved.
7. Field Service inputs received.
8. Engineering project head is identified.
RE: Corporate Policy Memo 75-8.
RE: There is no Business Plan without inputs by Manufacturing people.

3 — PRODUCT DESIGNED

PURPOSE OF EVENT: To freeze product definition and complete design to sufficient degree so that program can proceed on schedule & prototypes can be built which are of a design that manufacturing can build & product planning can be controlled.

TASKS REQUIRED FOR EVENT TO OCCUR:
1. Product Specification including:
   A. Functional specification,
   B. System configuration definition &,
   C. Reliability performance have been completely defined & frozen.
2. Product Specification is under change control.
3. Product Specification has been translated into design Mfg. can build.
4. Design has passed Design Review, DEC STD 007, Steps 2, 3, & 4.
5. Preliminary product documentation completed such that prototypes can be built.
6. Product design coordinated as appropriate with Mfg., Field Service & Product Lines.

55 — PHASE II BUSINESS PLAN (MANUFACTURING PLAN) APPROVED BY MANUFACTURING ENGINEERING COMMITTEE

PURPOSE OF EVENT: For New Product Team to publish & secure approval of a Manufacturing Plan which specifies & facilitates product schedule, quality, cost & budget so that every team member knows what to do & when, & so other parts of the company can proceed with product's plans based on New Product Team's commitment.

TASKS REQUIRED FOR EVENT TO OCCUR:
1. All parts of the Mfg. plan are completed, specifying product schedule, quality, cost & budget goals.
2. The strategy & resources for achieving goals have been identified by/for team members.
3. Plan has been approved by M-E Committee.
4. 2 X 2 Managers have been hired and installed.
5. Plan has been published & committed to by New Product Team.
6. All key functional New Product Team Managers have been hired & installed.
7. Provision has been made for the plan to be updated (rev control).
8. The Phase II Business Plan has been approved of which the Mfg. Plan is a part. Phase II requires a completed prototype.

67 — LIMITED RELEASE OF PRODUCT DOCUMENTATION

PURPOSE OF EVENT: To transmit all the product documentation from Engineering to Manufacturing, under change control, that manufacturing requires to begin securing material, people, & process equipment to be ready for the Pilot Run.

TASKS REQUIRED FOR EVENT TO OCCUR:
1. At least one prototype has been built, debugged, & is operating to the published product specification, functional specifications.
2. And to selected system configuration(s) specifications.
3. All build product documentation is complete, including fab, logic, assembly, etc., &
4. Is the same as the prototype unit.
5. Has been signed off by both the Mfg. & Eng. 2 X 2 Team members.
6. And is under change control.
7. DEC STD 007 Design Review Steps 5, 6, & 7 passed.

68 — PRODUCT ANNOUNCEMENT

PURPOSE OF EVENT: To announce the product to the outside world such that orders can be solicited & booked with full assurance that company contract commitments can be met.

TASKS REQUIRED FOR EVENT TO OCCUR:
1. The 2 X 2 Team has made final commitment to Mfg. cost
2. Product pricing is finalized by Product Lines. 2 X 2 Team & Product Lines have agreed & commited:
3. To build schedules
4. To build numbers and,
5. Configuration mix.
6. Product design has been sufficiently tested such that 2 X 2 Team can commit to product performance & reliability on a schedule.
7. Announcement package is complete
8. First Customer Ship is 3-6 months away.
9. Product has been announced.

69 — PILOT RUN COMPLETED

PURPOSE OF EVENT: To debug the actual mfg. process all the way through mfg. by building a small number of units before production of a large number of units is begun.

TASKS REQUIRED FOR EVENT TO OCCUR:
1. DMT, SMT, 102 & 060 tests have sufficiently qualified product design to justify risk of Pilot Run.
2. Product Lines & 2 X 2 Team have agreed & committed:
   A. To build schedule,
   B. To build numbers,
   C. To configuration mix.
3. Pilot units have been built only
   A. Using latest rev product documentation.
   B. Using latest rev process documentation.
   C. In selected Mfg. plant,
   D. By Mfg. personnel.
   E. Using process equipment & documentation to be used at production commencement
   F. Completed pilots, as product will be shipped to 1st customers, has been successfully evaluated for
      1) Unit functionality.
      2) System functionality
4. All process documentation is under change control
5. New Product Team agreed process sufficiently debugged to begin production.
6. Pilot strategy/method determined for future options, enhancements & configurations.
7. Product availability commitment for Field Service evaluation & training has been met.

70 — PRODUCTION BEGUN

PURPOSE OF EVENT: To produce units for sale:
- on schedule
- at quality
- at cost

TASKS REQUIRED FOR EVENT TO OCCUR:
The following tests qualifying product design (on prototypes) have been completed, proving the product to the Product Specification:
1. Design Maturity test for reliability & functionality.
2. System Maturity Test on selected (2 X 2 Team) configuration(s) for functionality.
3. DEC STD 102, 060 environmental & safety.
4. Pilot run has been completed.
5. Continuous availability of sufficient material, personnel & other resources are assured.
6. PMT Plan is final drafted.
7. PMT has begun.
8. Construction of production units has begun.
9. Plan for transfer of product mfg. responsibility to steady-state plant organization agreed to by plant.
10. Field Service & 2 X 2 Team have agreed & committed to Field Service spares schedule & spares test process.
11. Design Review DEC STD 007 has been completed. (Step 8).
12. Final release of design documentation has been made.

71 — FIRST CUSTOMER SHIPMENT MADE

PURPOSE OF EVENT: To meet contractual commitment to first customer of the product.

TASKS REQUIRED FOR EVENT TO OCCUR:
Shipment of the 1st product unit has been completed:
1. At quality plan goal – unit & system level.
2. Field Service has accepted product.
3. Customer has accepted product.

72 — PMT (PROCESS MATURITY TEST) COMPLETED

PURPOSE OF EVENT: To conclusively demonstrate that the mature stabilized product is being produced to quality goal by a stable process so that process can be controlled.

TASKS REQUIRED FOR EVENT TO OCCUR:
The PMT plan has been carried out & has conclusively demonstrated, using a representative sample quantity of the product, that the process is sufficient to produce product at the desired end goals specified in the Mfg. plan of:
1. Product at cost,
2. Product at quality,
3. Product at quantity,
4. A strategy/method plan exists for PMT of future process changes, ECO's & Product enhancements & options.

73 — FIRST QUANTITY SHIPMENT MADE

PURPOSE OF EVENT: To complete process of:
- initial product build meeting commitments.
- Product documentation
- Introduction strategy.
- Transfer to steady-state manufacturing organization in controlled & predictable manner.

TASKS REQUIRED FOR EVENT TO OCCUR:
1. Product is being shipped to schedule.
2. Product is being shipped at final quality goal.
3. Product is being shipped at interim cost goal.
4. Above has been achieved at Quantity, I.E., at a monthly rate which is 65% of the average of the monthly rates projected for the next 12 months.
5. PMT is completed.
6. Suitable product documentation is available for External Mfg. or another plant.
7. New Product Team members have been reassigned.
8. Plant organization has taken over responsibility for product manufacture.

CHART 1 Rev 3
D. Kuyamjian 5/13/77

What Can Manufacturing New Products do for You?

- Direct you to the right Manufacturing people to help you with information or assistance you may need on product cost, process design, schedule, and budget estimates.
- Identify your Manufacturing partner for your 2X2 Team described in Chapter 2.
- Assign you a temporary Manufacturing 2X2 Team member for your "Before the Beginning" phase so you can get Manufacturing commitments as you need them.
- Help you put together your New Product Team.
- Identify the plant in which your product will be built.
- Help you get commitments from the plant.

What Does Manufacturing New Products Need From You?

- Coordination and communication relating to product design, process design, and materials, to name just a few. The coordination Manufacturing needs with Engineering on new products is described in more detail in Manufacturing's General New Product Start Up Plan. You can get copies of this plan book from the group or plant New Product Managers, or from Debby Kuyamjian, X2397 in Maynard.
- Coordination and communication in developing the Engineering and Manufacturing Introduction Plans for your product's introduction. Manufacturing has a PERT based Project Planning Package which can help you and your New Product Team develop an *effective* product introduction plan so that your team people will know:
  What they're supposed to do
  When they are to do it
  How well they are doing

  You can get copies of the Project Planning Package from the group or plant New Products Managers, or from Clare-Marie Matthews, X6127 in Maynard

How to Use the New Product Organization

Finding the Right People
An organization chart for Manufacturing New Products is on the next page. If you don't know who to speak with in Manufacturing, call the group New Product Manager responsible for the type product you want to discuss. He will either help you or direct you to the right people.

CPUs	Don Chace, X330, Acton
Terminals	Les Goldman (Acting), X3864, Maynard
Disks/Tapes	Joe Cleary, X226, Acton
FA&T (System Integration)	Gene Stringer, X210, Salem

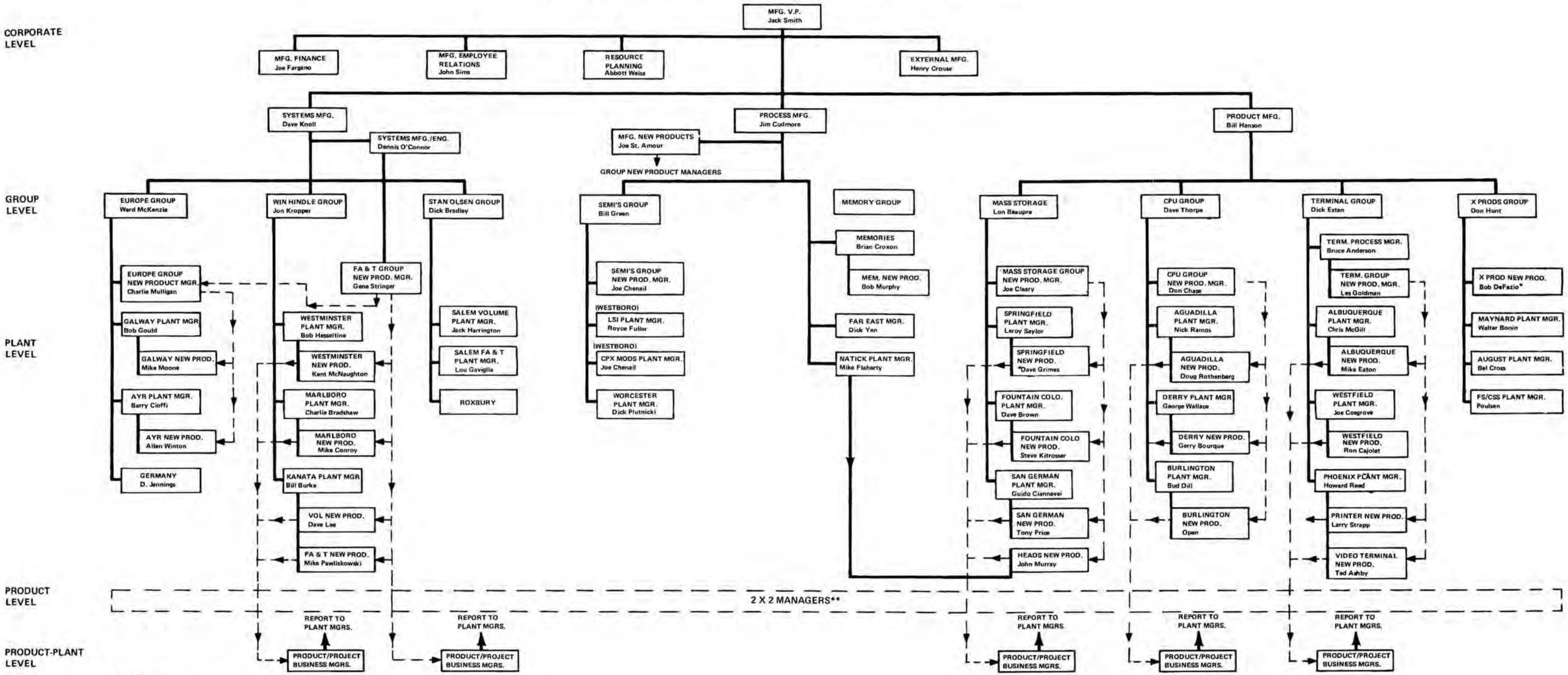
Specific Assistance
Manufacturing New Products has Process Consultants who are available to explain the benefits and use of the Project Planning Package.

Project Planners are members of the New Product Team who are catalysts and keepers of the new product's introduction plan. The Process Consultants can assist you in the hiring and training of Project Schedulers. Contact Clare-Marie Matthews or Brenda Buchanan, Ext: 6127 and 7978.

General Manufacturing Information Available on New Products

What	Contact
General New Product Start Up Plan A road map guide of what needs to be done to introduce a new product into DEC Manufacturing.	Group or Plant New Product Managers, or Debby Kuyamjian, Ext: 2397
New Product Introduction Reference Library Collection of tools, policies, and sample plans relating to new product introduction into DEC Manufacturing. Includes sample Manufacturing and PERT plans for various type products.	Group or Plant New Product Managers, or Debby Kuyamjian, Ext: 2397
Project Planning Package Users handbook on how to plan a new product introduction and how to use PERT5, the PERT-based computer program for project scheduling.	Clare-Marie Matthews (also included in Reference Library), Ext: 6127
Slate Book, New Product Introduction Quarterly review of Manufacturing's efforts to improve its new product introduction process.	Joe St. Amour, Ext: 2596
Polka Dot Book Quarterly review of all new products presently being introduced into Manufacturing.	Joe St. Amour, Ext: 2596 (restricted distribution)
DEC Standard 130 – Guide For Product Business Plans How and what to write for Phase I and Phase II Business Plans, which are required to secure authorization and funding for New Products.	Doris Bellemere, Ext: 2954 (also in Reference Library)
Manufacturing Catalog of Reports A directory of the reports Manufacturing compiles in order to measure and control its performance.	Joan Richer
Manufacturing/Engineering Organization Directory Who's Who.	Marie Mangan, Ext: 5328

MANUFACTURING LINE ORGANIZATION SHOWING MFG. NEW PRODUCTS DOTTED LINE ORGANIZATION



* = ACTING

** 2 X 2 MANAGERS ARE TYPICALLY BUSINESS MANAGERS, BUT MAY BE PLANT OR GROUP NEW PRODUCT MANAGERS. BUSINESS MANAGERS ALSO REPORT DOTTED LINE TO THE 2 X 2 MANAGER FOR THEIR PRODUCT, IN ADDITION TO THEIR PLANT NEW PRODUCT MGR. 2 X 2 MANAGEMENT IS PRODUCT FOCUSED RATHER THAN PLANT OR GROUP FOCUSED.

MA-0446

3.36.1.5 Central Mechanical Manufacturing Engineering - The operational structure of the Central Mechanical Manufacturing Engineering organization is presently as follows. Refer to the Directory for Updates (see Paragraph 3.36.1).

CENTRAL MECHANICAL MANUFACTURING, ENGINEERING
(MANAGER, JOHN BARDONE)

- SERVICE GROUP — MECHANICAL MANUFACTURING ENGINEERING DEPARTMENT (ENGINEERING SUPERVISOR, DON DEAMICIS)
  - MANUFACTURING ENGINEER, PROCESS ENGINEER, QUALITY ENG.
  - PRODUCTION SUPPORT SPECIALIST - ED MAXWELL
    MAINTAINS A CLOSE PROBLEM SOLVING INTERFACE WITH DEC SATELITE PRODUCTION AREAS ON NEW PRODUCTS
- ENGINEERING CONSULTANTS
  - PLASTICS SPECIALIST - TOM SEILER
    TECHNICAL CONSULTANT TO ALL PROJECTS INVOLVED WITH THE APPLICATIONS AND PROCESSES OF PLASTIC COMPONENTS
  - MATERIALS SPECIALIST - JOE SKILLINGS
    TECHNICAL CONSULTANT FOR ALL ENGINEERING MATERIAL APPLICATIONS WITH SPECIFIC EMPHASIS IN METALLURGICAL AREAS
  - METALS PREPARATION AND FINISHING – ART CLOCKEDILE
    HANDLING OF OPERATIONAL ASPECTS OF METAL PREPARATION AND FINISHING
- SERVICE GROUP — TOOLING ENGINEERING DEPARTMENT (ENGINEERING MANAGER, FRED OLDFIELD)
  - TOOLING DESIGN AND DEVELOPMENT
  - NUMERICALLY CONTROLLED PROGRAMMING
  - ADVANCED MANUFACTURING CAD/CAM R&D
- SERVICE GROUP — NEW PRODUCT PURCHASING DEPARTMENT (J. BARDONE, ACTING PURCHASING AGENT)
- NEW PRODUCT BUYERS, PART OF CENTRAL MANUFACTURING TEAM

MA-0441

When Should You Contact Central Mechanical Manufacturing Engineering?

New Product Managers should interface with Central Manufacturing at project inception, where a Manufacturing Team will be assigned. The Manufacturing Team (consisting of Manufacturing, Quality Tooling Engineers, Process/Materials Specialists, and New Product Buyers) will work with the Design and Production organizations to develop schedules, budgets, tooling requirements, inspection techniques, and product cost goals and remain part of the New Product task force until volume production goals are satisfied.

An ad hoc product review is used to evaluate the above requirements at the development of the Project Proposal; participants are:

- Design Engineering Team (2×2)
- Manufacturing Engineering and Department Specialists
- Tooling and Process Engineers
- Purchasing Team
- New Product Manufacturing Team (2×2)

This approach is instrumental in establishing a mutually agreed upon project strategy and in uniting the key participants into a cooperative working team.

What Central Mechanical Manufacturing Engineering Can Supply to You

Manufacturing Engineering

- Develop specific manufacturing processes that optimally suit the parts
- Define and develop manufacturing tooling
- Define and develop inspection processes and instrumentations
- Verify the process and quality capability of the vendors

Tooling Engineering

Tooling Design

- Design, develop, and evaluate all new product tooling requirements
- Design and develop inspection gauges and instrumentation
- Design and develop assembly fixturing for production sites
- Evaluate and endorse all high volume tooling contracts for concept and cost

NC Programming

- Develop and optimize the numerically controlled machining tapes for our in-house manufacturing facilities

Research and Development

- Develop computer aided design and manufacturing techniques via an interactive PDP-11/70 system
- Develop and implement graphic techniques into an archive for future new product development
- Optimize programs to "determine" the best metal working methods

What Central Mechanical Manufacturing Engineering Needs From You

- Notification of your intention to introduce a new product into Manufacturing
- Preliminary Engineering Specifications and design concepts
- Participation in ad hoc product reviews
- Intended volume production

3.36.1.6 Component Engineering - Component Engineering is a functional organization made up of three "interactive" coordinated efforts - Resident Component Engineering (Component Engineer assigned to a specific Design Engineering group), Corporate Component Engineering, and Plant Component Engineering - all united in a time phased plan to give support to the planning, introduction, and maintenance of purchased parts.

Component Engineering's mission is to ensure the use of purchased components which are optimized for performance, availability, and cost, to enhance the manufacture of cost-competitive and reliable DEC products.

When Should You Contact Component Engineering?

- During the design phase of your project at which time the Resident Component Engineer can provide direction on new and proper technologies.

- Prior to releasing your product to Manufacturing; the Resident Component Engineer can assist you in introducing your product to Manufacturing.

- Prime contacts located in ML6B-3, E21
  Nelson Velez, Cost Center Manager - Ext. 5348
  Paul Waitkus - Ext. 4627
  Paul Nix - Ext. 4558
  George Bumstead - Ext. 4477
  Jerry Jeansonne - Ext. 345 (LSF)

What Component Engineering Can Supply to You
Component Engineering provides technical support and direction to Manufacturing and Engineering on the selection of purchased components. They provide the documentation to assure that parts are procurable, testable, and compatible with manufacturing processes based on the following expertise.

- Depth and breath of knowledge in vendor processes and materials as applicable to DEC's needs. Ability to relate from the component level, to the application, and to the system level.

- Awareness of industry trends and individual suppliers technology, strengths and weaknesses.

- Ability to devise techniques for maintaining in-depth awareness of vendor materials, processes, strengths and weaknesses.

- Capable of developing program techniques and criteria to prevent, anticipate and solve purchased component problems in all purchased component related Data Base Systems and Computer Aided Design Programs.

Component Business by Commodity

- Component Consulting
  - Application analysis
  - Component evaluations
  - Industry trends
  - Problem solving
  - ECO service to Cross Products (Change Order involving more than one product)
  - Assembly Library Module (ALM) - Library of physical dimensions and pin layout of various components. Data Base for CALDEC and IDEA Systems used by Design Drafting.
  - Simulation of Asynchronous Gate Elements (SAGE)
  - Simulator for Integrated Circuits and Network Simulation (SLIC)

- Component Vendors
  - Qualified Vendor List (QVL)
  - Master Parts File (MPF) - Contained in EPLS
  - Component Marking and Identification
  - Purchase Specifications
  - Qualification Specifications
  - Sourcing

- Component Usage
  - Bill of Material (BOM) Analysis - Rating of preferred parts used as listed in all BOMs
  - Used on Listing
  - Component trends

- Component Test and Inspection
  - Incoming Inspection specifications
  - Equipment specifications
  - Inspection and test philosophy
  - Test and inspection plans

Resident Component Engineer
Provides the following services to Design Engineering

- Direction on New and Preferred Technologies
  - Benefits
  - Risks
  - Cost $
  - Schedules
  - Seminars
  - Problem Solving

- Vendor Interface on
  - Specification
  - Testing
  - Sourcing
  - Schedules
  - Qualification
  - Problems

- Assist in getting product to Manufacturing by interfacing with:
  - Purchasing (Corporate and Plant)
  - Specification Control
  - Component Engineering (Corporate and Plant)
  - Material Control
  - Incoming Inspection
  - Process Engineering
  - Manufacturing

- Communicating Engineering requirements to Corporate Component Engineering:
  - Schedules
  - Part Number Request Form (PNRF)
  - In Process Part (IPP)
  - Special projects

- Maintain a knowledge of responsibilities of other component responsibilities outside classical Component Engineering domain.
  - Fabrication
  - Metal
  - Chemical
  - LSI
  - etc.

Corporate Component Engineering Services

Corporate Component Engineering provides the following services to Design Engineering in support of the Resident Component Engineer.

- Reliability Data
- Quality consulting with regard to components
- Manufacture of components
  - Specifications
  - Vendor surveys

- Training in Component Engineering skills
- Failure analysis
- SEM (Scanning Electron Microscope) evaluation
- Component cross sectioning and photography and X ray
- Qualification Lab

  - Qualification of parts
    - Mechanical
    - Electromechanical
    - Electrical
    - Electronic
  - Life tests
  - Heat (temperature cycling)
  - Flammability
  - Humidity
  - Leak (gross) tests
  - Package integrity
  - Chemical
  - Hipot
  - Solderability
  - Critical mechanical dimensions

- Incoming Inspection System Support
  - Test diagnostics
  - System Software
  - Hardware support (i.e., load boards)
  - Distribution of hardware and software
  - Maintenance of status of test capability

What Component Engineering Needs From You
An understanding of the Component Engineering structure.

References and Requisites That Help Make a Good Relationship
The Component Engineering organization offers a one-half day informational seminar specifically designed for the Design Engineering community. This seminar provides individual designers with the information required to make optimum use of Component Engineering resources. Topics covered include:

- New Part Introduction
- Engineering Change Orders
- Informational Resources; The Purchase Part System
- Component Engineering Services

To enroll in this seminar or for furthur details, call Component Engineering, Ext. 5963 Maynard, MA.

Designers not participating in this seminar should become familiar with the following documents:

- Engineering Notes: (Available from Component Engineering)
  - 1.5 How to Introduce a New Purchase Part into DEC Design
  - 1.6 Six Simple Steps to Help Ensure the Success of Your Project, if it Uses New Purchased Parts
  - 1.7 Component Engineering Signatory Authority for Part Number Request Form
  - 3.10 Purchased Parts Information System
  - 3.11 Vendor Notification Program
- DEC Standards
  - 060 DEC Policy Relating to Nationally and Internationally Recognized Testing Laboratories
  - 100 Engineering Change Order Procedure
  - 119 Digital Policy and Practices Relative to Product Safety
  - 133 Integrated Circuit Documentation and Test Systems Control
- Component Engineering Signatory Authority List

Component Engineering also publishes a Component Engineering Newsletter (Component News), and a Directory of Personnel. For information call Component Engineering, Ext. 5963 Maynard MA.

3.36.2 Purchase Specification Department (Prime Contacts: John Peachey and Bill Burns)

When Should You Contact the Purchase Specification Department?

- When engineering design is firm and a DIGITAL part number and Purchase Spec are needed
- Whenever a question arises that is vendor/document related.

What the Purchase Specification Department Can Supply to You
A central repository containing a wealth of purchased parts information.

- Purchased Parts Information
  Assist engineer with purchase specification related problems.

  Unique DIGITAL Part Number – Each properly completed and approved Part Number Request Form will be assigned a unique DIGITAL part number by the Purchase Specification group.

  Purchase Specification Generation and ECO Processing – Research, edit, write, and type purchase specifications to established DIGITAL formats.

  EDP Data Entry – The purchased parts data will be coded and entered into the Purchase Spec Data Base, EPLS, and Manufacturing Master Parts File for corporate wide usage (Parts Lists, BOMs, etc.).

  Purchase Specification Distribution – Via microfiche machines (with weekly updates), and microfilm (reproduction/microfilm areas).

  Component Index Books – Create, edit, publish, and distribute both Multi-class and 90 Class Component Index books – updated and available periodically.

  Bi-Weekly Bulletin – Listing of new part numbers assigned (with related data) and ECOs received (with related data).

  Incoming Inspection Procedures – File, maintain under ECO control, and distribute (via microfiche and microfilm).

  ROM/PROM Coordination – Assign pattern numbers, supply "how to" information for documenting pattern, and coordinate information with Design Library, LSI Test Center, and vendor.

- Vendor Information

  VSMF – Microfilm cartridges of most vendor catalogs (subscription, updated monthly). Given the vendor name, the engineer can find the vendor address, phone number, local sales office and phone number, a list of products that the vendor offers, and a catalog sheet of those products.

  Given the commodity type, the engineer can find which companies manufacture it, and catalog sheets from those companies.

  Selected Vendor Catalogs – Primarily those that DIGITAL deals with most frequently.

A Qualified Vendor Listing (QVL) sorted by DIGITAL part number and Purchased Parts Lists (PPLs) which are sorted by vendor part number and vendor name. The QVL and PPL data is available on microfiche machines; no hard copy distribution is available.

The address, phone number, and vendor code number of all DIGITAL suppliers.

What the Purchase Specification Department Needs from You

- Good purchase specification inputs
- Positive response when requested for additional component/vendor information necessary for completion of Purchase Specification
- Positive response when requested to review and sign off a finished specification
- Sufficient lead time to establish workable priorities for completion, review, and approval of specifications.

Management Tools That Help Make This Relationship

- DEC STD 012 (Part Numbering Scheme)
  All purchased parts released to volume manufacturing must reflect a DIGITAL assigned part number (i.e., 10–99 Class) before parts lists/BOMs can be finalized, Purchasing will order, and inventory control can process material.
- DEC STD 055 (Purchase Specifications)
  Prior to part number assignment a Part Number Request Form (EN-01008B-R675-491) must be approved by Component Engineering (technical issues) and Purchasing Commodity Manager (business issues) for the particular part or sub-system being introduced. A convenient "One-Stop Shop" method of approval is available which allows an engineer to leave his request form, attached data, and any quotes to date, with Component Engineering. Component Engineering, in turn, will arrange full approval and part number asignment. If the engineer so desires, he can bypass the "One-Stop Shop" and obtain the approval signatures and part number without assistance.
- DEC STD 100 (ECO Procedure)
  DEC Standard 100 establishes the procedure for writing, obtaining approval, and submitting the ECO to the Purchase Specification ECO Coordinator.

3.36.3 Purchasing

When Should You Contact Purchasing?
Contact Ron Morales during the planning stage of your product.

What Purchasing Can Supply to You
Purchasing can provide the long term business picture in the component selection process:

- Is the usage of that component type a long term viable approach?
- Will DIGITAL's existing and proposed usage outstrip the capability and willingness of the marketplace to provide?
- Is the cost structure of that component realistic relative to the actual quantity usage during prototype stages, pilot production, and high-volume production?

- Are we designing in specialty items that will limit DIGITAL's multiple sourcing capability and its ability to grow?

- What has been the historical relationship between that vendor and DIGITAL?

Commodity Managers are assigned to general part classes to assist you and the buyers in vendor selection, sourcing, and problem solving.

Steering Committees are formed to handle high-volume, repetitive on-going requirements. The purpose of a Steering Committee is to put DIGITAL in the best possible position to achieve ultimate pricing and delivery performance from the marketplace. These committees are composed of part class buyers from each buying location and a component ship responsibility for that commodity group.

What Purchasing Needs From You

- Specification Details
- Quality Standards

Management Tools That Help Make This Relationship
Follow procedures for completing a Purchase Requisition provided in the Secretarial Reference Manual, Section 16, which is available at your secretary's desk. You may also request a copy by memo from Ann Pratt, PK1/B11.

Internal Purchase Requisition - DEC 8 (49B)-1072-A-R575

- Usage - Whenever DIGITAL makes an outside commitment to a vendor, the Internal Purchase Requisition form is used, with the exception of inventory purchases as noted below. This form will be completed for all following commitments:

  Purchase of Services: Service agreements, consultant agreements, and maintenance agreements.

  Purchase of Material: Inventory (local plants have the option to use material explosions) and non-inventory expense items (supplies and engineering materials).

  Rentals/Leases of equipment.

  Capital Equipment: Please refer to Capital Equipment in the Miscellaneous section.

- Preparation - The Internal Purchase Requisition must be completed by the requisitioner before Purchasing can take any action. Lack of any information will result in a delay of order placement and return of the requisition to the requisitioner. If you follow the procedures, your contacts with the Purchasing group will run smoothly.

Purchasing Group Locations in Maynard

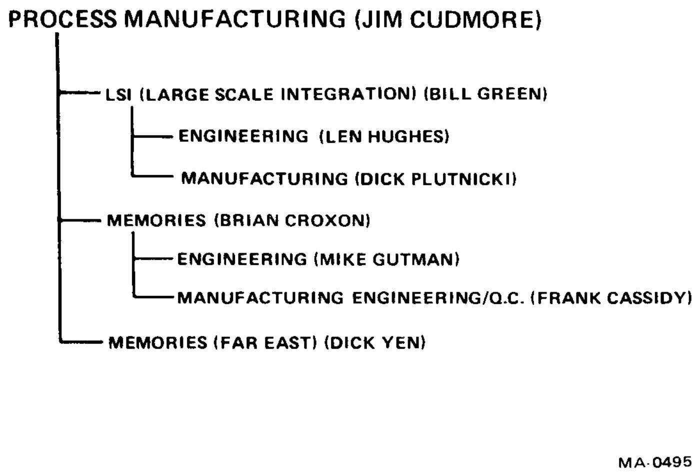
Field Services Purchasing - PK3-2
Engineering Support Purchasing - ML 1-3 and 5-4
Plant Engineering/Administrative Services Purchasing - ML 22-2
Maynard Manufacturing Purchasing - ML 5-4
New Product Purchasing - Phoenix - ML 1-3

NOTE

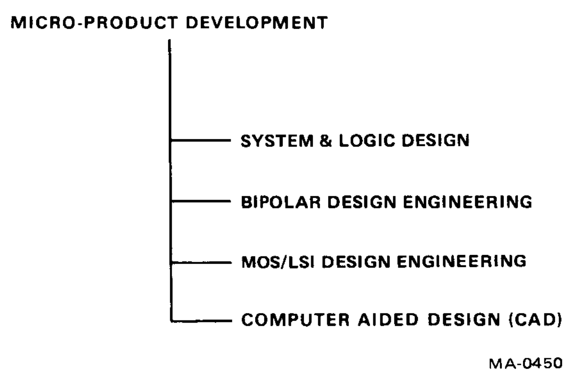
For information and help in other areas not listed above, contact Ron Morales.

3.36.4 Manufacturing and Engineering

The Manufacturing amd Engineering organization is responsible for components such as semiconductors and memories.

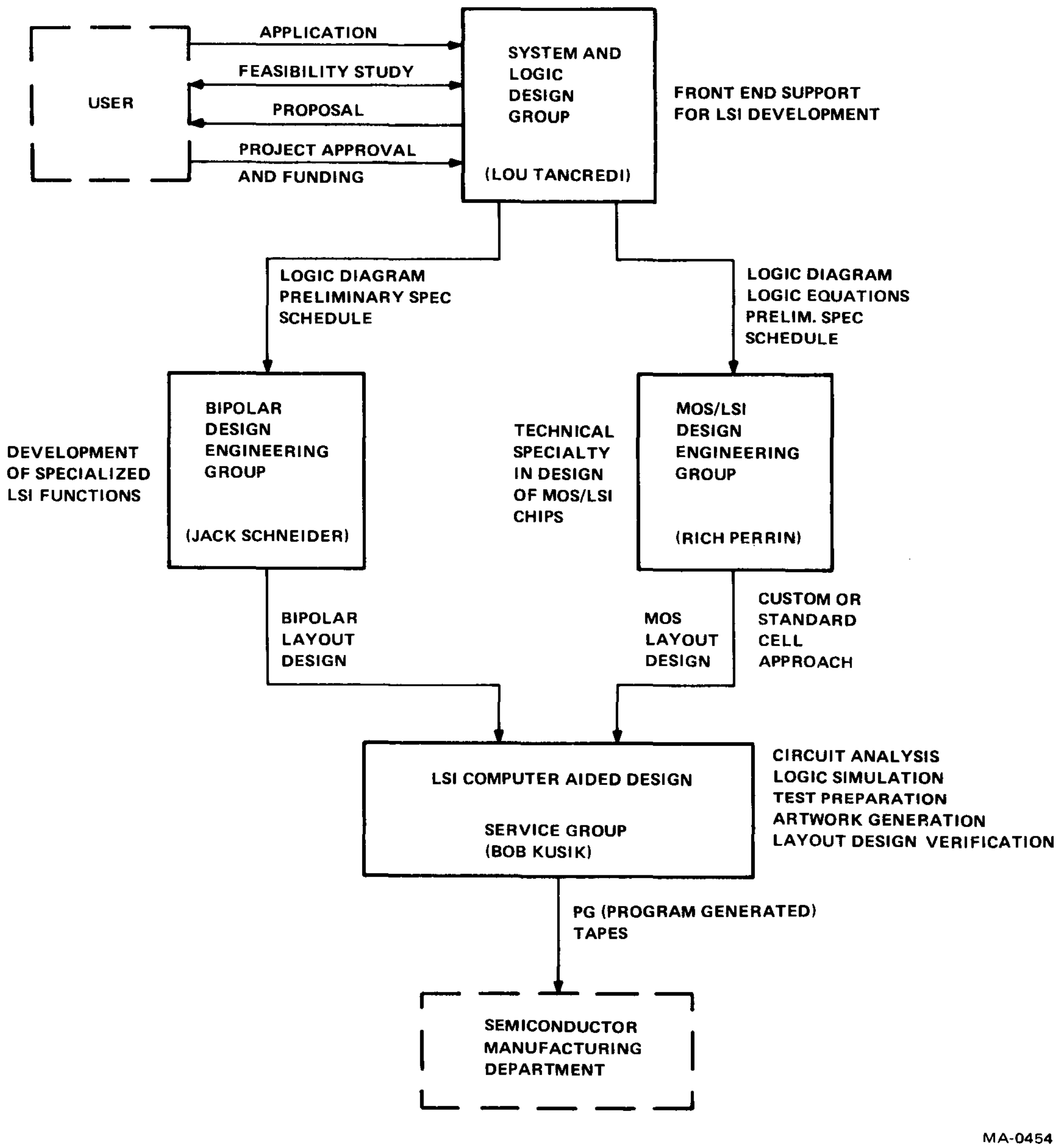


3.36.4.1 Micro-Product Development (Prime Contact: Bill Green) - Micro-Product Development designs custom LSI (Large Scale Integration) circuits that are not available commercially but are required for use in DEC products. Micro-Product Development comprises the following functional groups.



When Should You Contact Micro-Product Development?
When you need custom-designed LSI circuits and/or advice on commercially available LSI devices and technology. Also, when you have an idea for an LSI product which would have corporate wide application.

What Micro-Product Development Can Supply to You
The following flowchart depicts LSI developmental activities.



Computer Aided Design Functions

- Circuit Analysis - Steve Greenberg
  Circuit analysis of MOS and bipolar designs is performed by SLIC (Simulator of Integrated Circuits). The SLIC support/development team offers general user assistance and implements new features upon request.

- Logic Simulation - Peggy Wesley
  The SAGE2 (Simulation of Asynchronous Gate Elements) logic simulator is used as a design verification tool. The user may interactively monitor, examine, and modify his simulated network. SAGE support includes on-going development as well as documentation, tutorials, and application services.

- Test Preparation - Laurin Williams
  STUDD (Simulator and Tester Usage for Design and Diagnostics) provides software interfaces among the simulators and testers used within DEC. Its scope includes the generation and support of general testing aids. Development effort is directed by the user community.

- Artwork Generation - Dave Ressler
  Services include digitizing, editing, and plotting of artwork as well as the generation of PG (Pattern Generator) tapes. This group interfaces primarily with Micro-Product personnel and outside vendors for mask fabrication.

- Layout Design Verification - Ivan Dobes
  Prior to the generation of PG tapes, layout design verification programs are run (via CALMA* - an Interactive Graphics System) to check for connectivity and adherence to design rules. The Artwork Analysis group is responsible for the support and development of these LSI CAD tools.

What Micro-Products Needs From You
Your application requirements, including such factors as functional block diagrams, speed, power constraints, and schedule.

3.36.4.2 Semiconductor Manufacturing (**Manager, Dick Plutnicki**) - Semiconductor Manufacturing provides timely, economical, and adequate sources for all custom DEC-designed semiconductors or commercially available LSI devices. The entire make-buy process occurs within the LSI Materials Department which contains both the Commodity Managers and the LSI buyers. The LSI procurements are governed by normal sound purchasing practices with respect to vendors qualified by Central Incoming Test.

When Should You Contact Semiconductor Manufacturing?
When you believe that custom LSI design should be explored as a means of providing DEC the best solution to your particular needs or advise on the availability of commercial LSI devices. You should first contact the Manager of Microproduct Development. This will establish the interface between you, the user, and the circuit design engineers who will ultimately convert your needs to a manufacturable design, or the Purchasing people who will provide for your needs.

What Semiconductor Manufacturing Can Supply to You
Advice and/or hardware based on Manufacturing and Engineering expertise in the field of semiconductors.

What Semiconductor Needs From You
To know your needs.

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*CALMA - Tradename of supplier.

3.36.4.3 Electromechanical - Natick (Prime Contact: John Murray) - John Murray is Business Manager of floppy subassemblies and heads and is responsible for:

- Building or buying all magnetic heads incorporated into products by DEC production; decision to build or buy is dependent upon low or high volume requirements.
- Building or supplying floppy disks.
- Building precision electromechanical assemblies; close tolerance items.
- Performing Metrology tests } With relation to products
- Building special test equipment } produced by this group

When Should You Contact Electromechanical Manufacturing/Engineering?
As soon as possible, possibly during your product planning stage but no later than the design stage.

What Electromechanical Manufacturing/Engineering Can Supply to You

- Design and manufacturing experience in a variety of types of heads.
- Manufacturability do's and don'ts to fit in their processes.
- Ferrite services; memory/linear formulation and blendings for special applications.

What Electromechanical Manufacturing/Engineering Needs From You

- Rough functional specifications
- Personal contact; communications

3.36.4.4 Memory Manufacturing Engineering and Quality Control (Prime Contact: Frank Cassidy) - Memory Manufacturing Engineering and Quality Control provides support activities for all manufacturing sites producing and/or using major memories at DIGITAL. The focus of this activity is visible in three areas.

- New Product Introduction
- Manufacturing Engineering
- Quality Control

The following individuals are directly involved in this activity:

- Personnel who function as the focus for communication on engineering and quality issues for all DIGITAL plants.

- Stack Engineering and Memory Model Shop personnel.

When Should You Contact Memory Mfg. Eng. and Q.C.?
During the planning stage of your project.

What Memory Mfg. Eng. and Q.C. Can Supply to You

- New Product introduction of memories to production in the shortest amount of time.
- Manufacturing Engineering solves production problems and optimizes Cost/Quality/Production Rate of memories.
- Quality Control monitors yield level at incoming, in-process, outgoing and internal acceptance of memory products and recommends corrective action for problem areas.

The primary task of Stack Engineering is to support Stack Vendors and Design Engineering in core memory designs. The Memory Model Shop activities center around prototype stack assembly for Design Engineering and repair of Field Service and production stacks.

What Memory Mfg. Eng. and Q.C. Needs From You

- A preliminary design of the new product
- Tester design and build ready to start debug
- An agreement between Mfg. Eng. and Design Engineer for:
  Test plan for the New Product
  Board supply to start manufacturing evaluation

- Necessary changes to layout and completed final testing
- Agreement with Mfg. Engineering partner (2X2 Team) that product is ready for limited release.
- Agreement with Mfg. as to HOW, WHEN, and IF the following will be supplied.
  Quantity of boards and corresponding documentation supplied by you (including parts to assemble boards).

  Test equipment hardware and software

Reference Material and Requisites That Help Make a Good Relationship

New Product Introduction

- Manufacturing plans that include PERT-type charts
- Standard costs will be on file prior to shipment to Mfg. groups using the memories
- Prior to production release, all memories will have:
  PMT (Process Maturity Test) completed (first pass)
  DMT (Design Maturity Test) - MTBF validation - well under way to completion
  All Mfg. processes including Q.C. criteria completed and included in Local Document Control

- Goals include:
  Limited release to production - 3 months without problems; 6 months with problems
  Minimum build during New Product Phase - 200 units

Manufacturing

- All new memories to have manufacturing processes that ensure yields of 96% at system integration

- Existing major memories to be worked, such that a yield of 90% exists at system integration

- Production problems responded to within 48 hours (24 hours in the local Memory Manufacturing facility)

- Develop a detailed summary of manufacturing product cost (material, labor, and overhead breakdown)

Quality Control

- Failure/Corrective Action reports issued monthly
- Meet with Volume Manufactures and FA&T a minimum of once per quarter
- High volume incoming inspection process for semiconductor memory devices
- Update all memory (device, module, option) manufacturing sites with quality criteria as needed (minimum - once per quarter)

Stack Engineering/Memory Model Shop
Stack Engineering will develop initial manufacturing processes for new designs and transmit them to the Far East (3–4 months prior to stack delivery) and respond to all stack problems within 48 hours (24 hours in local Memory Manufacturing facilities).

The Memory Model Shop, under guidance of New Product Engineering, will assemble prototype stacks with an agreed upon schedule, and repair Field Service and production stacks as a complement to the prototype stack workload.

3.36.4.5 Memory Systems Engineering – Memory Systems Engineering is responsible for defining available, suitable memory technologies and the development of essentially all main memory systems. System designs fall into one of two categories; those that benefit a number of Product Lines or computer families and those that are oriented toward either specific machine or Product Line. Development of the first category is usually forecasted by the related group and funded by Central Engineering. The second category is funded directly by the group requesting Memory Systems Engineering services. Definition and development of suitable devices and system techniques associated with memories in general is funded entirely by Central Engineering.

Examples:

- System Concepts defined and explored
  - Battery Backup
  - Error Correction

- Devices currently under consideration
  - Various semiconductor RAMs
  - Charge Coupled Devices (CCDs)
  - Bubbles (magnetic memory for computer storage)
  - Alterable ROMs

When Should Memory Systems Engineering be Contacted?
Contact may be made directly with anyone in the group to discuss any specific problem or task related to the group functions. Contacts are made by the hardware group or Product Lines with a unique need to people at various levels within the group, mostly to either managers or to senior people.

Management Contacts

- Product Manager (Mike Gutman)
- Engineering Manager (Richard Morris)
- Engineering Supervisor/Traditional Systems (Pete Durant)

Group Senior Member Contacts

- CCDs, Bipolar and MOS Designs (George Hitz)
- MOS Designs, ECC (Error Correction Code) (John Manton)
- CORE/MOS Designs, System Concepts (Don Smelser)
  CORE/Bubbles (Cliff Granger)

The preceding contacts represent a partial listing of Memory Systems Engineering persons and their area of expertise; this does not imply that they are limited to those areas only. Many other people within the group are knowledgeable and can provide help in applicable areas.

What Memory Systems Engineering Can Supply to You
Advice, consultation, and direction in memory technology and development

What Memory Systems Engineering Needs From You
A description of your problems or tasks.

NOTE
Commitments and thorough definition of the group strategy is a management responsibility. You may often find that your needs closely match their development efforts but may not however coincide within your time frame. The Memory Systems Engineering group is open to comments and criticisms and can be convinced to alter their plans when presented with suitable and valid arguments.

3.36.5 Materials (Manufacturing Planning Manager, Abbott Weiss)

Material availability is ensured for all manufacturing plants by the Manufacturing Planning organization, located in Maynard. Materials groups for high-volume, Systems and Components Manufacturing are located at respective manufacturing (worldwide) plants. Your Manufacturing Partner and the Materials Manager, working with the production control people and machines, are responsible for ensuring that the materials required are available within the time frame specified for the complete manufacture of your product.

3.37 DIGITAL COMPONENTS GROUP (DCG)

The DIGITAL Components Group provides specific focus on the low-end microcomputer and terminals markets. The term "components" refers to the method of selling basic pieces of computer systems, analogous to the stereo components systems business. The customer is responsible for the selection and integration of the individual pieces, and in return obtains higher performance at a correspondingly lower cost. The overall goal of the Components Group is to pass on significant savings to the customer by:

- Efficient high volume distribution methods
- Highly reliable products with above average mean-time-between-failure and minimal on-site initial failures
- Cost/performance ratios that are competitive with independent suppliers of similar products
- Minimal bundling of built-in services and costs with the product, such as 1 year warranties, software support, on-site integration, in return for lower prices.

The Components Group is organized into three major Product Lines:

- Logic Products (PL 58)
  The Logic Products group is the original modules organization which founded the company. It is responsible for the distribution of general purpose interface modules, custom module products, and hardware and cables.
- Terminals (PL 56)
  The Terminals group focuses on the marketing and sales of high-volume hard copy and soft copy terminals such as the LA36 DECwriter and the VT52 DECscope.
- Microcomputers (PL 53)
  The Microcomputer Product Line focuses on the marketing and sales of the low-end microcomputers and associated products. The current microcomputer being marketed is the LSI-11.

What the Components Group Engineering Organization Can Supply
Design, engineering support, and product assurance services to each Product Line via the following groups.

Systems Development
This group develops products specifically for the microcomputer and Logic Product Lines. It is responsible for much of the interface products and hardware development associated with the LSI-11. In addition, it is working with Central Engineering on new microcomputer products.

Terminals Engineering
This group works solely for the Terminals Product Line and is responsible for the development of specific terminal products to meet market requirements as needed. In addition, this group works closely with Central Engineering terminals development in the design of joint products and specifications for the next generation of terminal products.

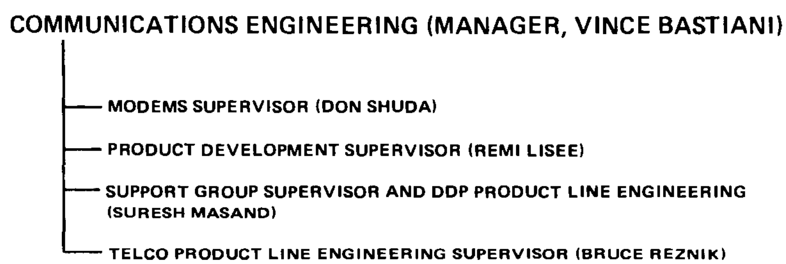
Product Assurance and Support
Due to the unique requirements for reliability, warranty expense, and the support of high-volume manufacturing, this group has been established to focus specifically on those elements concerning the above mentioned items. The Product Assurance group works closely with either Product Line Development or Central Engineering Development to ensure that the standards required by the Components Group concerning failure rates and warranty expenses are met. In addition, it provides substantial feedback to the Design groups in terms of field performance of the products and the impact of changes to the product currently in the field.

Group Interaction
The Components Group engineering organization, of all the Product Line engineering organizations, interacts much more closely with Central Engineering Development. This is because significant volumes of products are sold by the Components Group and the feedback obtained from actual customer usage and their applications is vital to the corporation in determining advanced product strategy.

When Should DCG be Contacted?

- When information on DCG developed products is required
- Any time an ECO affects products designed or sold in volume by DCG
- Any time a quality reliability issue affecting a DCG customer is uncovered

3.38 COMMUNICATIONS ENGINEERING
The Communications Engineering group provides the 11 family with a complete set of Serial Interface products. Main emphasis is on common carrier operation but does not preclude local connection. The group structure and responsible people (Prime Contact: Vince Bastiani) are given below. This group also provides Product Line Engineering functions to TELCO and DDP (Distributed Data Processing) Product Lines.



MA-0506

When Should Communication Engineering be Contacted?
Whenever communication options for the PDP-11 family are required and/or when questions need to be answered on data communication standards.

What Communication Engineering Can Supply

- Since their primary emphasis is in common carrier applications, knowledge of modems, interface techniques, and requirements.

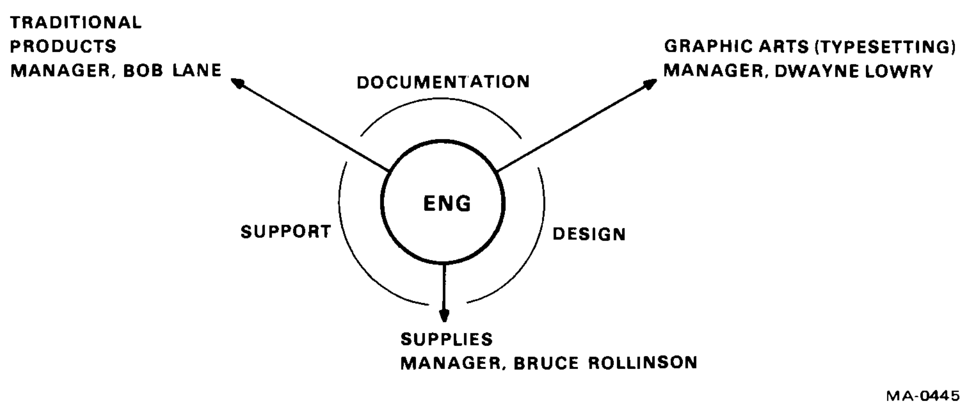
- Assurance that other communication products within DEC are consistent, i.e., act as a resource of communication knowledge

What Communication Engineering needs to Achieve Their Goals
The requirements and needs for communication equipment of the various Product Lines.

Reference Material Available Within Communication Engineering
A library of listings:

- Bell System Interface Specifications
- EIA Specifications (Electronics Industry Association)
- ANSI Standards (American National Standards Institute)
- CCITT Specifications (Comite Consultatif Internationale de Telegraphie et Telephonie)

3.39 TRADITIONAL PRODUCTS/TYPESETTING
The Traditional Products/Typesetting organization contains two Product Lines, each having its own charter which defines the scope of operation and commitments associated with it.



Traditional Products
A product is transferred to TPL manufacturing when the volume is too low for DEC's high volume manufacturing area, or if the product has been replaced by another product, and in both cases, only if TPL has the expertise to manufacture the product.

- Provides continuing support for established customers by offering original add-on peripherals.
- Provides newer option capability to the traditional customer base.
- Establishes a used computer market for DIGITAL processors and peripherals.
- Provides a sales outlet for DIGITAL surplus and obsolete equipment.

Graphic Arts (Typesetting)

- Develops and markets worldwide, a full line of typesetting and text management products to the printing and publishing industry (SIC Code 27XX) and all "captive" or inplant typesetting and printing facilities of any company, with initial emphasis on the Fortune 500 companies.

- Develops and markets worldwide, business (EDP) systems for newspaper, commercial printing, and radio/TV segments of our marketplace through both turnkey software application packages and software tools (operating systems and utilities).

Engineering Group, Manager Jim Milton
The Engineering group provides design, support, and documentation to the Traditional Products and Typesetting groups. Engineering also provides these services to the Supplies organization which stocks all consumable accessories, such as punch cards, magnetic tapes, disks, ribbons, paper tape holders, etc.

When Should Traditional Products/Typesetting Engineering be Contacted?
Whenever informal exchange of technical expertise is desired by other engineering groups.

3.40 BUSINESS PRODUCTS
The Business Products Engineering department provides product development and technical support services for a group of Product Lines that sell small computers to the commercial marketplace. As the DIGITAL message of putting computing power directly into the hands of the user becomes accepted in the data processing world, they find many expanding markets for commercially-oriented versions of PDP-8 and PDP-11 computer families.

When Should Business Products be Contacted?
The Hardware Engineering area of Business Products (Prime Contact: Brian Fitzgerald) should be contacted primarily by commercial Product Lines as early as possible during the planning stage of their product.

What Business Products can Supply

- Specify and design commercial small computer systems that are built around standard corporate products.

  Examples
  - Datasystem 310 series, based on the PDP-8/A processor
  - Datasystem 570 series that use the 11/70 CPU

  In most cases the standard products are enhanced with special packaging features that are suited to the office environment of the EDP user.

- Design and develop products that are specifically aimed at the commercial markets, such as the LQP-8, Letter Quality Printer used for word processing applications and the H9820 Computer Desk.

- Provide technical support to Marketing, Sales, and Manufacturing, particularly with respect to the Datasystem family of products.

The Business Products department often works on joint projects with Central Engineering when a modified version of a standard product for our Datasystems is needed.

What Business Products Needs to Accomplish Their Goals

- Product Plans
- Description of small systems needs

3.41 WORD PROCESSING (Product Line 40)

The Word Processing Engineering group is responsible for the planning, development, and support of all Product Line unique hardware products. Word Processing software products are developed, under contract, by a dedicated team within the Commercial Software Development organization. The Word Processing Product Line does not sell "computer" equipment. The fact that their products use computers to achieve their capability is a "don't care" to their customers. Therefore, the downtime and environmental requirements of the computers of the 60s and early 70s are not acceptable in Word Processing Systems. Components for Word Processing Systems must be engineered for a "consumer-like" environment. They must be human-engineered, rugged, and self-validating.

The Word Processing Product Line needs components that take the system into account. They market integrated, bounded, low-cost systems; they are very sensitive about cost, weight, and space since most of their products go into existing offices.

Due to the fast moving, competitive rate of their market, they attempt to be very responsive; on a new product they "shadow" a central project, being right behind it in synchronized movement, merging a component into their systems.

From the early production units they require first evaluation samples, then units for hardware and software systems development, and finally some quantity (2–50) for field demonstrations – all prior to any customer shipments.

When Should You Contact Word Processing?

The most critical time is PRIOR to the project becoming officially specified and funded; including technology projections.

Contacts

Hardware issues, Bob Gray – Engineering Manager
Software issues, Ke Shih – Software Group Supervisor
Business Strategy issues, Jack Gilmore – Product Line Manager, or Dick Munn – Marketing Manager

What Word Processing can Supply to You

- Word Processing Applications Requirements – Provide you with information on your specific needs and characteristics of the market and the competitors in the market. Give you informal reaction to new product ideas and also share in long range plans.

- New Product Sponsorship – For product ideas that are likely to meet future business requirements, work closely with Central Engineering and Product Management in sponsoring product development within the management structure and decision making processes.

- Hands-on Experience with Present Products – PDP-8 and VT78 based products are in use throughout the company; however, if you need access to a system, units are available in New Hampshire both during and after normal working hours. The Word Processing group would like you to be as turned-on a user as they are.

Word Processing Functions

- Responsible for the Letter Quality Printer (LQP78). New system variations are developed by the Word Processing group.

- Package central products into Word Processing Systems (WS78).

- Develop new products (H335 switch) that are required for their market.

- Evaluate "foreign" add-ons (OCR readers, phototypesetters, magcard readers).

What Word Processing Needs From You
Good open communication during all phases of a new product. Once a program is going, they need accurate data on the development plan.

Future Equipment Requirements

- Displays – Full page displays with high quality character sets as well as graphics.

- Storage – Aggressively track floppy and bubble-like storage techniques and build them into word processing work stations.

- Interconnection – Cheap expandable methods that do not have a high front-end cost to interconnect work stations. The interconnections will be used for printer sharing, document sharing, and for electronic mail.

- Output – Electronic connections to copiers and phototypesetting devices will become important.

3.42 CORPORATE LIBRARY
The Corporate Library is located in the "Mill" complex in Maynard with a satellite branch located in Marlboro. These facilities are available to all DIGITAL employees.

Prime Contacts

- Library Policy – Karen Feingold
- Reference, SCAN, Purchase Recommendations – Carolyn Sweeney, Margery Goldstein
- Purchasing, Competitive Literature – Renate Baptiste
- Reserves and Renewals – Betsey Cane
- Journals and Newspapers – Helen MacFadyen
- Video Courses and Audio Cassettes – Cathy Sidelinger
- Marlboro Library – Michelle Ahlquist

When Should You Contact the Corporate Library?

- Maynard Library Hours – 7:30 a.m. to 5:00 p.m.
- Marlboro Library Hours – 8:15 a.m. to 5:00 p.m.
- Both libraries are accessible after hours; for information call X6231 in Maynard, ML5-4, or X5040 in Marlboro, MR1-2

What the Corporate Library can Supply to You

- SCAN Service
  An automated system for the retrieval of printed information on subjects ranging from engineering, to education, to environmentalism; from marketing to management to mechanics. Sources for this service include such major journal indexes as *Computer and Control Abstracts* and *Engineering Index*, as well as the Library of Congress, NTIS, ERIC, and Predicasts.

- Information
  From books, journals, newspapers, conference proceedings, audio and video cassettes, standards (commercial and military), competitor publications, and many other sources.

- Materials on Loan
  Everything in the library except reference books, video cassettes, and current issues of journals can be borrowed for two weeks by any DIGITAL employee. Reserves and renewals may be arranged by phone or in person.

- Assistance
  In ordering printed matter, subscriptions, and memberships.

- Access
  Borrowing cards for MIT libraries and Harvard's Baker Library and resources of other libraries worldwide.

- Specific Engineering Supplies
  Engineering notebooks, software templates, MIL HDBK 217B.

What the Corporate Library Needs From You

- Cooperation
- Responsible use of library materials
- Compliance with loan procedures
- Recommendations of materials to purchase

3.43 MARKET DATA CENTER

The Market Data Center is located in PK3-1, Parker St. Maynard MA. The Center provides a central resource of marketing and competitive information that can be utilized by all Product Lines, Sales, Planning, and Engineering personnel. It is divided into the following functional areas.

- Market Data Center Library
- Customer History Data Base

When Should You Contact the Market Data Center?
Whenever you require assistance. Call Yolanda Brown, Ext. 2504, prior to visiting the Market Data Center.

What the Market Data Center Can Provide for You
The Market Data Center Library provides the following services:

- Collects and organizes marketing-related information
- Answers reference inquiries
- Aids in research for specific projects
- Distributes the monthly Market Data Center Memo which reviews newly acquired reports
- Lends and distributes information such as reports to requestors

Collection consists of:

- Research Reports – Current collection consists of over 300 reports with subjects that range from in-depth analysis of specific products to a broad overview of certain industries. Included in the reports area are two continuing subscription services; Stanford Research Institute's Long Range Planning Service and International Data Corporation Planning Service. Both services supply marketing reports of all types on a regular basis.

- Competitive Files – These files consist of general, publicly available information on DEC's competitors. The information in these files is collected from current newspaper and magazine articles, news releases, company brochures, and manuals. Ten thousand reports are also available on major competitors. A selected group of product manuals of major competitors is also maintained including the manuals of IBM, Data General, Hewlett Packard, Honeywell, and Sperry Univac.

- Collection also consists of:
  Reference Manuals – Auerbach, Datapro, and others
  Annual Reports – The Fortune 1000 companies
  Consulting Organizations/Data Sources – Organizations involved in marketing research
  International File – Contains market-sizing information on the foreign marketplace
  Reference Books – Include D & B Directories, Thomas' Register, Moody's, Standard & Poors, State Industrial Directories, Who Owns Whom Directories, and Foreign Corporations Directories.

  Also, Industry Surveys, Industrial Outlook, Market Intelligence Reports on Military/Government Marketplace.

  Periodicals – Include Harvard Business Review, Journal of Marketing Research, Sales Management, Fortune, Duns, Forbes, Datamation, Computerworld and Electronic News.

  Industry Newsletters – EDP/Industry Report, EDP Weekly, Autotransaction Industry Report, Microcomputer Digest, EFTS Industry Reports, Small Business Computer News, Micrographics Newsletter, Packaged Software Reports, etc.

  Data Files – IDC Domestic Computer Installation Data File, IDC OEM/Systems House Data File, Mini-Micro Systems Data Base Market File. Printouts of the files are maintained by MDC; these files are also available on magnetic tape.

Computer History Data Base (Jerry Todd, Ext. 3631)
This is a computerized data base of DIGITAL's U.S. customers, showing bookings back through FY72. At the present time there are only a limited number of scheduled output reports (all quarterly). These are volume analysis reports for NORAM, NORAM Regions, National Accounts and Product Lines. All other requests are handled on an individual basis (normal turnaround is two to three days).

CHAPTER 4
RESOURCES/REFERENCES

4.1 SCOPE
There are many organizations within DIGITAL who provide services and relevant publications that are available to you. A brief description of these resources and reference material, and procedures on how to obtain them are presented in this chapter.

4.2 DIGITAL AND YOU
This booklet covers various topics about the company, its basic employee policies, your paycheck, advancement, etc. Your supervisor and/or personnel representative can help you find the answers to any questions you may have that are not answered in this booklet. The booklet is distributed by the Personnel Departments within the United States. Personnel Departments outside the U.S. generate their own booklets covering topics about the company relevant to the areas in which they reside.

4.3 DIGITAL THIS WEEK (DTW)
A weekly newsletter is published for employees of Digital Equipment Corporation in the United States. Copies are available at the various plant entrances on Mondays.

4.4 DIGITAL THIS WEEK (Field)
A consolidated DTW is published monthly and mailed to field branch offices worldwide.

4.5 DECWORLD
A corporate periodical is published and mailed to employee's homes in the United States. Sufficient copies are mailed to DIGITAL officials overseas for distribution to all employees.

4.6 DIGITAL TELEPHONE DIRECTORY
The DIGITAL Telephone Directory is available to all DIGITAL employees at Stationary Stockrooms throughout DIGITAL's facilities. Your department secretary can direct you to the proper source or get one for you. The following information and procedures are contained in the directory.

- North America Customer Assistance
  Extension and location
  Important numbers to know within DIGITAL facilities in Massachusetts

- How to Update
  Includes updating information and change of extension form.
  Additional forms are provided in the back portion of directory.

- Metropolitan Boston Telephone Service

- Dialing Instructions for Maynard DIGITAL
  WATS, Metropolitan Boston, long distance, international dialing, local calls

- Telephone Services from Maynard Only
  Credit cards, Telephone Service Request, conference calls, transferring calls

- Corporate Message Services
  Corporate Message Services (DECNET)
  Maynard and Marlboro Message Centers
  Corporate Message Services Station Codes

- International Suggested Calling Times
- World Holidays
- Domestic Suggested Calling Times
- Mail Services
  Post Office
  Interoffice
  Field Office
  Mail arrival/departure schedules
  Special services
  General information

- Location Codes
- Order Processing Groups
- Personnel Listing
- Departmental Listing
- Domestic Office Listings
- Canadian Office Listing
- International Listing (European)
- General International Area (GIA)
- International Distributors
- Emergency Numbers (Massachusetts Facilities)
  Fire
  Medical
  Security
- Schematic of Intra-company Calling

4.7 TRANSPORTATION (Interplant)
Aircraft and van transportation services are available to and from the various DIGITAL facilities in the New England area. The van schedules are posted on bulletin boards throughout the facilities. Aircraft schedules are posted at the entrances to the facilities and paper fliers are available from the receptionists or security guards.

4.8 SECRETARIAL REFERENCE MANUAL
This manual is available at your secretary's desk or you may request a copy from Ann Pratt (PK-1/B11) by memo. Some of the information in this reference manual is provided in the *Engineer's Orientation Manual*, however, additional information such as DIGITAL history, executive officers, overview of facilities in Maynard and Westminister, a map of the Mill Complex, personnel policies, communication, travel, and your departmental procedures may be of interest to you.

4.9 COMMUNICATION SERVICES

A Communication Services Index is issued for use by all DIGITAL employees who have a need for publications stocked and distributed by the Communication Services group. The index includes the following types of publications.

- Promotional Material
  - Brochures
  - Option Bulletins
  - Data Sheets
  - Price Lists
  - Application Notes, etc.
- Hardware Manuals (Hard Copy)
- Illustrated Parts Breakdown (IPB)
- Software Products Description (SPD)
- Purchase/Discount Agreements
- Some Blank Forms and Vendor Manuals

Customer Inquiry Service

Fulfills your requests primarily for promotional type literature where the inquiry is the result of a DEC advertisement, publicity, trade show, or other promotional activity. They also fulfill requests you send with respect to this type literature for individuals outside DIGITAL.

Send your requests to:
Northboro, MA.
Supervisor Ext: 403
Order Service Ext: 401

Publication /Forms Bulk Order Fulfillment

Operation is the subsequent distribution of primarily bulk quantities of the majority of DEC promotional materials, technical documentation, and general-use printed forms to all DIGITAL employees. A listing of all materials available from this operation is found in the Publications Index. Orders are normally placed by a "Literature Contact" who is appointed by the Cost Center Manager where there is a regular and frequent requirement for materials of this nature.

Establishing a new Literature Contact

- The Cost Center Manager is requested to send a memo to Northboro, listing:
  Name(s) of designee(s)
  Office location
  Mail Stop
  Cost Center (to be charged when applicable)
  Literature Contact's badge number

  The Literature Contact's name is added to the mailing list. A copy of the Publication Index is made available and updates to the Index are mailed as available.

Entering an Order for Material

- A Request For Literature form must be filled out and mailed to Communication Services, NR2/M15; urgent requests can be sent via Corporate Message Services (per instructions in the Publications Index).

- Please be sure to accurately indicate "part" (publication or form) numbers as listed in the Index. Titles or other code numbers are *not* acceptable input.

- Telephone orders and incomplete requests *cannot* be processed.

Detailed information on how to order is provided in the introductory pages of the Index. Request for Literature forms are available from Communication Services via memo. All inquiries should be addressed to:

Digital Equipment Corporation
444 Whitney Street
Northboro, MA 01532
Attn: Communication Services (NR2/M15)
Customer Services Section

4.10 ENGINEERING INFORMATION LOCATOR

This document contains a brief description of publications developed by various DIGITAL departments and the persons to contact to obtain a copy.

Content Categories:

I	Company Policies, Standards and Specifications
II	Financial Information
III	General Reports and Documents Available
IV	Company Newsletters
V	Library Publications
VI	DEC Committees - Membership and Charters

To obtain a copy, call the Corporate Library located in the Mill Complex ML5-4/A20, Extension 5821.

4.11 DEC COMMITTEES

A *company confidential* publication of the various DEC Committees, membership, and charters is issued semi-annually. Requests for copies should be made to CIS/Information Handling Services, PK3-2/B31, Extension 3875. A listing of the committees, respective chairman and secretary, and their location and extension is provided below.

Committee	**Chairman Secretary**	**Location**	**Ext.**
Computer Aided Design	Ed Vrablik	ML1/E24	4931
	Lu Abel	ML1/E24	4221
Computer & Data Communication Resources	Dana Hoyt	PK3-2/S55	2666
	Pauline Nist	PK1/E33	4730
Corporate Order Administration	Al Crawford	PK3-2/F34	2305
Documentation Review	Leo Bennett	ML4-4/E99	6310
	Steve Vazella	ML1-4/F16	3784
Engineering	Ed Corell	ML1-3/E62	2991
	Allan Kent (Asc. Chr.)	ML4-4/E99	8701
	Carl Noelke	ML3-2/A16	6208

Engineering Review Board	Dave Potter	ML3-5/E35	4637
	Bill Kelly	ML3-3/E95	3962
Field Management	Ted Johnson	PK3-2/A55	5942
	Paul Vilandre	PK3-2/F28	5437
Finance - Administration	Al Bertocchi	PK3-2/A56	5311
	Mike Rashkin	PK3-2/F24	5537
Manufacturing	Jim Cudmore (App. ea meet.)	ML1-4/E30	2393
Manufacturing/Engineering	Dick Clayton	ML3-3/E71	3638
	Abbott Weiss	ML1-4/P69	2551
Marketing	Ted Johnson	PK3-2/A55	5942
	Bill Thompson	ML12-1/F41	3779
Office of Development (Organization)	Gordon Bell	ML12-1/A51	2236
	John Meyer	ML12-1/A11	2633
Operations	Ken Olsen	ML12-1/A50	2301
	Bill Thompson	ML12-1/F41	3779
Patents	Tom Siekman	PK3-2/F17	4422
Personnel	Win Hindle	ML5-2/A53	2338
	Barry Burns	PK3-1/A32	4656
Product Line Managers	Ted Johnson	PK3-2/A55	5942
	Bill Thompson	ML12-1/F41	3779
Product Safety	Ron Minezzi	PK3-2/S20	3122
	Larry Sieminski	PK3-2/S20	2621

4.12 RAINBOW BOOKS

Rainbow Books are reports produced and distributed by various organizations. The following listing identifies these reports by color and title, distribution, and responsible contacts. A more descriptive presentation of the Rainbow Books is available in the Manufacturing Planning, Catalog of Reports produced by the Manufacturing Planning organization (Maynard, ML1-4, Ext. 2551).

Red Book I

Management Summary and Justification of Central Engineering Development Budget
Produced semianually, Fall and Spring
Distribution limited and strictly controlled
Produced by Engineering Office of Development
Contact: Stan Pearson, Ext. 2424 (ML12-3, Maynard MA)

Beige Books
Product Strategy by Product Class/Family
One each for:
CPUs, Large Computer Group, Memory
LSIs, Communication, Hardware, Software
Produced semiannually, Fall and Spring
Distribution limited and strictly controlled
Distributed to:
Marketing Committee, Central Engineering
Plant Management, New Products Group, Others
Produced by Engineering Office of Development
Contact: Stan Pearson, Ext. 2424 (ML12-3, Maynard MA)

Blue Book
Manufacturing Management Report
Produced monthly
Distribution limited; sections of Blue Book referencing overall company plans of a highly confidential nature are strictly controlled.
Distributed to:
Plant and Corporate Manufacturing Management,
Product Line Engineering, and Corporate
Administrative Management
Produced by Manufacturing Planning
Contact: Abbott Weiss, Ext. 2551 (ML1-4, Maynard MA)

Green Book
Manufacturing Cost Reports
Produced monthly
Distributed in full to Product Line Managers, Controllers, Corporate Management; selected pages are distributed to Plant Management.
Produced by Manufacturing Financial Control
Contact: Bob Tancreto, Ext. 6035 (ML1-4, Maynard MA)

Pink Book
Option and Basic System Average Actual Cost
Produced quarterly
Distributed in full to top management and is available for reference in Manufacturing Financial Control; partial and single-page copies distributed to Product Managers and Plant Managers.
Produced by Manufacturing Financial Control
Contacts: Ralph Lent, Ext. 3841 (ML1-4, Maynard MA) and John Kuda, Ext. 3669 (ML1-4, Maynard MA)

Red Book II
Monthly Flash Report – Series of Financial Reports
Produced on the fourth working day of each fiscal month
Distributed in full to the Operations Committee, Corporate Finance Vice Presidents; selected pages go to the Product Lines. Produced by Corporate Internal Reporting
Contact: Norm Kalat, Ext. 3626 (PK3-2, Maynard MA)

Brown Book
Product Line and Area Financial Statements
Produced monthly
Distribution limited and strictly controlled
Produced by Internal Reporting
Contact: Austin O'Connor, Ext. 6137 (PK3-2, Maynard MA)

Yellow Book
Engineering and Products Yellow Book – Detailed Description of the Status of Engineering Projects
Produced monthly
Distribution limited and strictly controlled
Produced by Central Engineering
Contact: Curt Rawley, Ext. 8969 (PK3-1, Maynard MA)

Black Book
Management Overview of Process Strategies, Planning and Budgeting
Produced semiannually, Fall and Spring
Restricted distribution to MFG. Committee, ME Committee, MFG. Staff, ENG. Managers and MFG. Engineering Managers
Produced by Jim Cudmore
Contact: Marguerite Shaw, Ext. 6576 (ML1-4, Maynard MA)

Orange Book
Management Summary of Functional Strategies, Planning and Budgeting of PL96 and 97
Produced semiannually, Fall and Spring
Restricted distribution to Engineering and Manufacturing Senior Managers
Produced by Jim Cudmore and John Sims
Contact: Lee Hayes, Ext. 7083 (ML1-4, Maynard MA)

Slate Books
Strategies by Process and Function, Planning and Budgeting
Produced semiannually, Fall and Spring
Open distribution, but Company Confidential
Produced by Managers of Related Processes and Functions

Process Manager		**Ext.**	**Location**
Bill Green	Integrated Circuits	2220	ML1-2
Frank Cassidy	Memory Options	5317	MO (Marlboro)
Mike Flaherty	Fine Electro Magnetic Assembly	110	NA (Natick)
George Wood	Metals	379	AC (Acton)
John Caulfield	Boards	544	AC
Dave Hurlbut	Backplanes	391	AC
Brian Fitzpatrick	Backplanes	328	KA (Kanata)
Jim Melvin	Modules	3076	WM (Westmins.)
Joe Cleary (Acting)	Disks/Tapes	5366	ML1-4
Art Berner	CPU	450	AC
Bob Ericson	CPU		
Dennis O'Connor	FA&T	210	NS (Salem)
Russ Feener	FA&T	3116	WM
Al Jones	System Logistics	5931	ML1-4

Functional Manager		**Ext.**	**Location**
Joe Fargano	Finance	2410	ML1-4
Abbott Weiss	Planning	2551	ML1-4
Art Lally	Inventory Control	3375	ML1-4
Bob Grimes	Information Systems	6377	ML1-4
Carl Kooyoomjian	Distribution	393	NR (Northboro)
John Sims	Personnel	6633	ML1-4
Jim Cudmore	Manufacturing Engineering	2393	ML1-4
Joe St. Amour	New Product Start Up (NPSU)	2596	ML1-4
Gene Mondani	Quality Control (QC)	2933	ML1-4
Nelson Velez	Component Engineering	5348	ML6B-3

Polka Dot Book
Manufacturing's report on new products being introduced in Manufacturing
Produced quarterly
Distribution limited and strictly controlled
Produced by Central Manufacturing Engineering New Products
Contact: Joe St. Amour, Ext. 2596 (ML1-4/E29 Maynard MA)

4.13 DEC STANDARDS

DEC Standards are a documented source of information on Company Standards. All requests for DEC Standards are to be submitted to the DEC Standards Control group, located in the Mill Complex, ML4-2/E27, Extension 2954.

DEC Standard 001, Section 1 contains the Purpose, Scope, Source, Responsibility, Standards Approval Process, Revision Procedure, Distribution, Review Procedure and Format.

Section 2 contains an abstract listing of all DEC Standards, Revision and date, title and description, and the responsible person and his department.

4.14 EMPLOYEE TRAINING AND EDUCATION

Educational and training programs are available at DIGITAL which cover a broad spectrum that may contain development and growth opportunities applicable to you in meeting your career goals. Discuss your development needs and interests with your manager and personnel representative. They can guide you in selecting the appropriate activity that best meets your requirements.

A synopsis of the various educational and training activities available within the corporation and in the outside world is presented in the following paragraphs.

4.14.1 Growing People, A Guide to Employee and Management Development

This booklet was developed by the Management Employee Development organization and is addressed to Engineering, Product Lines, and Finance and Administration. A description of the services available and how to make use of them, supplemented by a six-month calendar of events of the various programs, is included to help you in planning future activities. Specific chapters provide Course Descriptions, University Programs, and Educational Resource Center functions.

Copies of this booklet are available from the Managers of Engineering organizations and from your Personnel Department.

4.14.2 Management Education Programs, Manufacturing

This booklet is published in January and July of each year by the Employee/Organization Development (E/OD) group which is part of the Manufacturing Employee Relations staff. It lists all the regularly scheduled supervisory and management development programs currently planned for the next six-month period.

Workshop descriptions include Central Manufacturing Management Development Programs and Management Development Programs offered by various plant groups. Separate chapters are devoted to brief listings of (1) training programs provided by other groups in the company, (2) outside courses, and (3) library materials available.

Anyone interested in acquiring a copy of this booklet should contact Linda Dee, ML1-4, Ext. 6093.

4.14.3 Sales Training Services

Sales Training's function is to design a suitable training program for our Sales force, establish a schedule for its implementation, develop the necessary materials, and conduct that program. The lead time to accomplish this is approximately one year prior to first customer ship of the new product. As

APPENDIX A
ORGANIZATION CHARTS

The organization charts provided in this appendix do not reflect the representative areas that are common to all organizations, such as Personnel, Secretarial, and Administrative. Emphasis has been placed in identifying the functional, Engineering and operational groups within each organizational structure. The charts are arranged in a parallel sequence coinciding with relevant group descriptions found in Chapter 3.

CORPORATE ORGANIZATION CHART
(SELECTED)

PRESIDENT, KEN OLSEN

- **ENGINEERING VICE PRESIDENT (Gordon Bell)**
  - RESEARCH AND DEVELOPMENT (Jim Bell)
  - COMPUTER SYSTEMS DEVELOPMENT VICE PRESIDENT (Dick Clayton)
  - SOFTWARE DEVELOPMENT VICE PRESIDENT (Larry Portner)
  - OPERATIONS/ADMINISTRATION VICE PRESIDENT (Bob Puffer)
  - MASS STORAGE DEVELOPMENT MGR. (John Kevill)
- **FINANCE VICE PRESIDENT (Al Bertocchi)**
  - CORPORATE INFORMATION SERVICES (Al Crawford)
  - ORDER PROCESSING (Al Crawford)
  - SECRETARY AND GENERAL COUNSEL VICE PRESIDENT (Ed Schwartz)
- **GROUP VICE PRESIDENT (Win Hindle)**
  - COMPUTER SPECIAL SYSTEMS (John Holman)
  - LABORATORY AND MEDICAL PRODUCT GROUPS VICE PRESIDENT (Ed Kramer)
  - LARGE COMPUTER GROUP VICE PRESIDENT (John Leng)
  - OEM GROUP VICE PRESIDENT (Bill Long)
  - INDUSTRIAL PRODUCTS GROUP (Charlie Spector)
  - EDUCATIONAL PRODUCTS GROUP (Jerry Witmore)
- **SALES VICE PRESIDENT (Ted Johnson)**
  - SOFTWARE SERVICES (Bruno Durr)
  - CUSTOMER SERVICES VICE PRESIDENT (Jack Shields)
- **MANUFACTURING VICE PRESIDENT (Jack Smith)**
  - PROCESS MANUFACTURING (Jim Cudmore)
  - PRODUCT MANUFACTURING (Bill Hanson)
  - SYSTEMS MANUFACTURING (Dave Knoll)
  - EMPLOYEE RELATIONS (John Sims)
  - EXTERNAL MANUFACTURING/DIST./PURCH. (Henry Crouse)
- **GROUP VICE PRESIDENT (Andy Knowles)**
  - COMPONENTS ENGINEERING (Ray Moffa)
- **GROUP VICE PRESIDENT (Stan Olsen)**
  - WORD PROCESSING PRODUCT LINE (Jack Gilmore)
  - BUSINESS PRODUCTS VICE PRESIDENT (Irwin Jacobs)
  - TRADITIONAL PRODUCTS/TYPESETTING (Bob Lane)
  - INFORMATION SYSTEMS GROUP VICE PRESIDENT (Julius Marcus)

COMPUTER SYSTEMS DEVELOPMENT
ORGANIZATION CHART

VICE PRESIDENT, COMPUTER SYSTEMS DEVELOPMENT (Dick Clayton)

- **PLANNING AND RED BOOK (Frank Sanjana)**
- **SYSTEMS ENGINEERING (Peter Van Roekens)**
  - SYSTEM MECHANICAL ENG. AND SUPPORT (Dick Gonzales)
  - SYSTEM PERFORMANCE EVALUATION (Ralph Platz, Acting)
  - CURRENT SYSTEMS ENGINEERING (Dick Testa)
    - CONFIGURATION ENGINEERING (Jim Barclay)
  - ADVANCED DEVELOPMENT FOR SPECIAL PRODUCTS (Peter Jessel)
  - SYSTEMS INTERCONNECT ENGINEERING (Howard Fineman)
- **UNIBUS-11 ENGINEERING (Jim Marshall)**
  - HIGH END SYSTEMS (Jim Marshall, Acting)
  - LOW END SYSTEMS (John Sofio)
  - ENGINEERING TECHNOLOGY (Nathan Parke)
- **SYSTEM/PRODUCT MANAGEMENT UNIBUS-11 (Mike Tomasic)**
  - CORPORATE PACKAGED SYSTEMS (Bob Flynn)
  - UNIBUS-11 CPU PRODUCT MANAGEMENT (Mike Tomasic, Acting)
- **SMALL SYSTEMS (Steve Teicher)**
  - PDP-8's AND CURRENT LSI-11 PRODUCTS (John Clarke)
  - INTERACTIVE TERMINALS AND SYSTEMS GR. (Len Halio)
  - LSI-11 PRODUCT MANAGEMENT (Dezi Dezzani)
- **ADVANCED-11 COMPUTER CHIPS (George Beason)**
  - FONZ-11 (Mike Titelbaum)
- **POWER AND PACKAGING SYSTEMS (Phil Tays)**
  - POWER AND PACKAGING PRODUCT MANAGEMENT (Joe Smith)
  - INDUSTRIAL PACKAGING AND ENVIRONMENTAL ENG. (Jim Lawrence)
  - PACKAGING DEVELOPMENT AND SUPPORT (Jim Lawrence)
  - POWER SUPPLY/RFI DEVELOPMENT (Paul Rey)
  - POWER SUPPLY ENGINEERING (Henk Schalke)
  - INDUSTRIAL DESIGN (Dick Schneider)
- **TERMINALS ENGINEERING (Ed Corell)**
  - GROUP ENGINEERING MANAGER (Art Williams)
  - VT62 DEVELOPMENT (Dick Brewer)
  - PRODUCT MANAGER (Alan Dziejma)
  - TERMINAL SYSTEMS ARCHITECTURE (Ken Fine)
  - PRINT HEAD DEVELOPMENT (Abe Gershnow)
  - SUPPORT ENGINEERING (Tom Stockebrand)
  - LETTER QUALITY PRINTER (Walt Tetschner)
- **OPTION DESIGNATION LISTS, DESIGN REVIEW (Dick Best, Carl Noelcke)**

SOFTWARE DEVELOPMENT AND ADVANCED SYSTEMS ORGANIZATION CHART

- VICE PRESIDENT, SOFTWARE DEVELOPMENT (Larry Portner)
  - STAFF CONSULTANT (Peter Christy)
  - CORPORATE MANAGEMENT DEVELOPMENT SPECIALIST (Jane Ward)
  - OPERATIONS MANAGER (John Rose)
  - TECHNICAL DIRECTOR (Bill Keating)
    - SOFTWARE STANDARDS (Pat White)
    - METHODOLOGIES (Bill Segal)
  - SOFTWARE DEVELOPMENT SERVICES MANAGER (Oleh Kostetsky)
    - SOFTWARE PUBLICATIONS METHODS (Armen Varteressian)
    - SOFTWARE PUBLICATIONS, NEW HAMPSHIRE (Norm Brimhall)
    - SOFTWARE PUBLICATIONS, MAYNARD (Norm Brimhall, Acting)
    - SOFTWARE PUBLICATIONS, MARLBORO (Steve Heiser)
    - SOFTWARE DISTRIBUTION CENTER (Ed Wright)
    - COMPUTER RESOURCES AND FACILITIES MANAGEMENT (Don Crowther)
    - SOFTWARE DOCUMENT PREPARATION (Cheryl Hogan)
  - REAL-TIME/COMPUTATION SOFTWARE SYSTEMS MANAGER (Bill Heffner)
    - SOFTWARE QUALITY MANAGEMENT (Brad Glass)
    - REAL-TIME/COMPUTATION SOFTWARE PRODUCT MANAGEMENT (Jack Mileski)
    - REAL-TIME SYSTEMS DEVELOPMENT (Bill Munson)
    - SMALL SYSTEMS DEVELOPMENT (Gil Steil)
  - COMMERCIAL SOFTWARE SYSTEMS MANAGER (Ed Fauvre)
    - SOFTWARE QUALITY MANAGER (John Morgan)
    - COMMERCIAL SOFTWARE SYSTEMS PRODUCT MANAGEMENT (Bill Picott)
    - COMMERCIAL APPLICATIONS (Tom Donovan)
    - COMMERCIAL SOFTWARE SYSTEMS DEVELOPMENT AND INTEGRATION (Bob Daley)
    - TRANSACTION PROCESSING SYSTEMS (TPS) AND LANGUAGES (Ron Ham)
    - OPERATIONS AND SERVICES (Jim Harnedy)
  - DISTRIBUTED SYSTEMS AND COMPONENTS (George Plowman)
    - DISTRIBUTED SYSTEMS PRODUCT MANAGEMENT (Chuck Stein)
    - DISTRIBUTED SYSTEMS SOFTWARE ENGINEERING (Mary Breslin)
    - EUROPEAN SOFTWARE ENGINEERING (Jim Wade)
    - DISTRIBUTED SYSTEMS PROGRAM MANAGEMENT (Kami Ajgaonkar)
    - DECsystem-10/20 SOFTWARE ENGINEERING (Ed Christiansen)

SOFTWARE DEVELOPMENT AND ADVANCED SYSTEMS (Cont.)
ORGANIZATION CHART

- **ADVANCED SYSTEMS (Bill Demmer)**
  - PROJECT OFFICE (Larry Coppenrath)
  - PRODUCT MANAGEMENT (Bernie Lacroute)
  - SOFTWARE PROGRAM MANAGER (Peter Conklin)
  - SOFTWARE DEVELOPMENT (Roger Gourd)
  - LARGE ENGINEERING (Len Hughes)
  - MEDIUM ENGINEERING (Steve Rothman)
- **DIAGNOSTIC ENGINEERING (Bill Johnson)**
  - MANUFACTURING TEST APPLICATIONS (Bill Moran)
  - AUTOMATIC SYSTEMS (Ollie Stone)
  - PROCESS/PRODUCT EFFECTIVENESS (Marv Horovitz)
  - DIAGNOSTIC SYSTEMS ENGINEERING (Bob Beck)
  - ENGINEERING PROGRAMMING (Peter Straka)

CORPORATE ENGINEERING SERVICES ORGANIZATION CHART

- **VICE PRESIDENT, ENGINEERING OPERATIONS (Bob Puffer)**
  - **CORPORATE ENGINEERING SERVICES MANAGER (Leo Bennett)**
    - ENGINEERING SERVICES SITE OPERATIONS (John Sartory)
      - MARLBORO ENGINEERING SERVICES (Roger Pothier)
      - PHOENIX ENGINEERING SERVICES (Jim Gillett)
      - MERRIMACK ENGINEERING SERVICES (Joe Madden)
      - MAYNARD DESIGN SERVICES (Ken Russ)
      - ENGINEERING MODEL SHOP (George Gerelds)
      - COLORADO SPRINGS DESIGN SERVICES (Mike Elkins)
      - TEWKSBURY ENGINEERING SERVICES (John Wanamaker)
    - CAD SYSTEMS ENGINEERING (Bert Bruce)
    - CENTRAL ENGINEERING SERVICES (Dick Reilly)
      - ENGINEERING INFORMATION PROCESS (Bill Seaver)
      - DRAFTING STANDARDS (Jerry Marini)
      - ENGINEERING INFORMATION SERVICES (Leroy Smith)
      - ECO DRAFTING, ADMINISTRATION, SUPPORT (Ray Melanson)

INFORMATION PROCESSING SERVICES
ORGANIZATION CHART

INFORMATION PROCESSING SERVICES MANAGER (Bill Svirsky)

- PLANS, PROJECT CONTROL AND INTEGRATION (Wayne Hall)
- BUSINESS MANAGEMENT (Dave Bromley)
- APPLICATION SUPPORT (George Newton)
- SYSTEMS SUPPORT (Craig Fletcher)
- DATA COMMUNICATIONS (Dave Cedrone)
- PERFORMANCE MEASUREMENT (Wayne Hall, Acting)
- HARDWARE ENGINEERING (John Kaufman, Acting)
- MANAGER CORPORATE IPC (Art Michaud)
  - OPERATIONS (Pauline Nist)
  - PRODUCTION CONTROL (Bart Mecum)
  - PRODUCTION PROCESSING (Jack Mckeon)
  - DISTRIBUTION (Walter Majewski)
  - CUSTOMER ASSISTANCE (Walter Broderick)
  - QUALITY ASSURANCE (Ed Gillen)
- MANAGER MERRIMACK IPC (John Gwinn)
- MANAGER WOBURN IPC (Bill Wallace)

COMPUTER SPECIAL SYSTEMS (CSS)
ORGANIZATION CHART

CSS GROUP MANAGER (John Holman)

- **MARKETING (Jim Bennett)**
- **HARDWARE ENGINEERING (Martin Hall)**
- **SOFTWARE ENGINEERING (Open)**
- **CENTRAL MANUFACTURING PLANNING (Phil Pietrowski)**
  - MATERIALS (Bruce Sheridan)
- **EUROPE (Bob Thorley) Reading**
  - NORTH EUROPE (Bob McPherson) Reading
    - NORDIC (Kristoffer Szczygiel)
      - MARKETING (Kristoffer Szczygiel)
      - HARDWARE ENGINEERING (John Atkins)
    - MARKETING (Graham Street)
    - UNITED KINGDOM (Bob McPherson)
      - SYSTEMS ENGINEERING (Eric Cocker)
      - MANUFACTURING (Geoff Oades)
  - CENTRAL EUROPE (Peter Maslowski) Munich
    - MARKETING (Jurgen Hertel)
    - HARDWARE ENGINEERING AND MANUFACTURING (Peter Reisser)
    - SOFTWARE ENGINEERING (Ernest Mezera)
  - SOUTHWEST EUROPE (Chris Michel) Paris
    - MARKETING
    - HARDWARE ENGINEERING AND MANUFACTURING (Christian Ryckboer)
    - SOFTWARE ENGINEERING (Philipe deLaubadere)
- **INTERNATIONAL (Bill Glover)**
  - JAPAN (Hiro Watanabe)
    - MARKETING (Ikuo Matsuoka)
  - AUSTRALIA (Wal Lamberth) Sydney
    - MARKETING (John Farkas)
    - HARDWARE ENGINEERING (Zorin Racic)(Bob Starkey)
    - SOFTWARE ENGINEERING (Peter Palethorpe)
  - CANADA (Bev Hallman) Kanata
    - MARKETING (Dave Murray)
    - HARDWARE ENGINEERING AND MANUFACTURING (Owen Fisk)
    - SOFTWARE ENGINEERING (Wade Frembd)
    - FINANCE

COMPUTER SPECIAL SYSTEMS (CSS) (Cont)
ORGANIZATION CHART

- **U.S.A. (Jerry Butler) Nashua**
  - FACILITIES (Stu Osborne)
  - NASHUA ENGINEERING SUPPORT (Dave Rasmussen)
    - PRODUCTS (Dennis Hopkins)
    - SOFTWARE ENGINEERING
    - ENGINEERING SERVICES (John Larkin)
      - ENGINEERING SUPPORT (Don Boots)
  - NASHUA MANUFACTURING (Russell Gullotti)
    - PRODUCTION (Paul Thorn)
      - PRODUCT ACCEPTANCE (Dick Brown)
    - MATERIALS (Geoff Matthews)
    - PURCHASING (Ken Scanlon)
  - WESTERN REGION (Fritz Aumann) Santa Ana, California
    - MARKETING
    - HARDWARE ENGINEERING (Bob Edwards)
    - SOFTWARE ENGINEERING (Gary Roberts)
    - MANUFACTURING (Bob Edwards)
    - FINANCE, ADMINISTRATION AND ORDER PROCESSING (Dan LeClair)
  - INDUSTRIAL/SCIENTIFIC (Alex Campbell) Nashua
    - MARKETING (John Stefanowicz)
    - HARDWARE ENGINEERING (Lin Olsen)
    - ADMINISTRATION AND ORDER PROCESSING (Karen Stevens)
  - COMMERCIAL (Frank Wroe) Nashua
    - MARKETING (Ken McDaniel)
    - HARDWARE ENGINEERING (Dick Nixon)
    - ADMINISTRATION AND ORDER PROCESSING (Pat Sloan, Ron Swanda)
  - OEM COMPONENTS (Emery Springer) Nashua
    - MARKETING (Jim Carroll)
    - HARDWARE ENGINEERING (Andy White)
    - ADMINISTRATION AND ORDER PROCESSING (Jerry Fournier)

LDP/MDP
ORGANIZATION CHART

- VICE PRESIDENT LDP/MDP (Ed Kramer)
  - LDP BUSINESS MANAGER (Frank Winiarski)
    - MATERIALS MANAGER (Herb Luther)
    - ORDER PROCESSING MANAGER (Bill Buttars)
  - MARKETING MANAGER EUROPE (Hans Steenman)
    - MEDICAL MARKET DEVELOPMENT MANAGER (Walter Huwyler)
    - LARGE SYSTEMS SUPPORT MANAGER (Steve Hort)
  - LDP PRODUCT LINE MANAGER (Joel Schwartz)
    - MICRO SYSTEMS MARKETING MANAGER (Allan Wallack)
    - MIDI SYSTEMS MARKETING MANAGER (Don Street)
    - MAXI SYSTEMS MARKETING MANAGER (John Mucci)
    - MINI SYSTEMS MARKETING MANAGER (Dick Wright)
  - GROUP DEVELOPMENT MANAGER (Bill McBride)
    - HARDWARE ENGINEERING MANAGER (Bill Avery)
    - SOFTWARE ENGINEERING MANAGER (Open)
    - GRAPHICS PRODUCT MANAGER (Herve Lavoie)
  - MEDICAL PRODUCT LINE MANAGER (Rob Katz)
    - IMAGE ANALYSIS PRODUCT MANAGER (Jim Plunkett)
    - MEDICAL INFORMATION SYSTEMS MARKETING MANAGER (George Thissell)
    - CLINICAL LAB PRODUCT MANAGER (Patricia Miller)

LARGE COMPUTER GROUP (LCG) HARDWARE ENGINEERING ORGANIZATION CHART

LCG HARDWARE ENGINEERING (Manager, George Hoff)

- **CONSULTING ENGINEER, ARCHITECTURE, (Alan Kotok)**
- **CONSULTING ENGINEER, TECHNOLOGY, (Pat Sullivan)**
- **PERIPHERAL/COMMUNICATIONS SUBSYSTEM (Franco Previd)**
  - TAPE/DISK/CHANNELS ENG. SUPERVISOR (Phil Wilson)
  - COMMUNICATIONS SUBSYSTEMS ENG. SUPERVISOR (Mike Drumm)
- **2020 DEVELOPMENT (Tom Dundon)**
- **SYSTEMS ENGINEERING (Vic Ku)**
- **TECHNOLOGY (Bill Walton)**
  - CIRCUIT GROUP SUPERVISOR (Open)
  - MECHANICAL SUPERVISOR Acting, (Jim McElroy)
  - MEMORY GROUP SUPERVISOR (Sultan Zia)
- **ENGINEERING SUPPORT-CURRENT PRODUCT ENGINEERING (Len Kreidermacher)**
  - CONTINUATION ENGINEERING
  - CURRENT PRODUCT ENGINEERING
  - DESIGN PROCESSING/PROTO ASSEMBLY SUPERVISOR (Joe McMullin)
  - PROJECT LEADER DECsystem-10/20 INTEGRATION (Ron Setera)

FEDERAL SYSTEMS
ORGANIZATION CHART

- FEDERAL SYSTEMS GROUP (R.G. Kleine)
  - DOD/OEM MARKETING (Fred Wilhelm)
  - CIVILIAN AGENCIES/FOREIGN GOVERNMENT MARKETING (Phil Wright)
  - SYSTEMS ENGINEERING (R.G. Kleine)
    - HARDWARE SYSTEMS (Steve Paavola)
    - SOFTWARE SYSTEMS (Dana Lajoie)

OEM AND PDP-8 GROUP
ORGANIZATION CHART

VICE PRESIDENT OEM AND PDP-8 GROUP (Bill Long)

- OEM AND PDP-8 FINANCE AND ADMINISTRATION MANAGER (Jim Pitts)
- OEM PLANNING MANAGER (Larry Wade)
- OEM AND PDP-8 MARKET DEVELOPMENT AND COMMUNICATIONS (Steve Coleman)
- OEM AND PDP-8 BUSINESS MANAGER (Bob Hesseltine)
- OEM AND PDP-8 MARKETING MANAGER EUROPE (Open)
- PDP-8 PRODUCT LINE MANAGER (Jim Willis)
- SMALL-11 PRODUCT LINE MANAGER (Joe Meany)
- SYSTEMS-11 PRODUCT LINE MANAGER (Art Campbell)
- OPERATIONS CONSULTANT (Clayton Rix)

INDUSTRIAL PRODUCTS GROUP ENGINEERING ORGANIZATION CHART

INDUSTRIAL PRODUCTS GROUP ENGINEERING MANAGER (Bob Savell)
- COMMUNICATIONS AND PROCESS I/O SYSTEMS MANAGER (Neil Slavin)
- INDUSTRIAL DATA COLLECTION SYSTEMS MANAGER (Ken Raina)
- INDUSTRIAL APPLICATIONS SOFTWARE MANAGER (John Holz)

EDUCATION PRODUCTS GROUP
ORGANIZATION CHART

EDUCATION PRODUCTS GROUP MANAGER (Jerry Witmore)

- **DEVELOPMENT MANAGER (Open)**
- **MARKETING MANAGER (Ron Spinek)**
- **GIA MARKETING MANAGER AND PLANNING (Bob Trocchi)**
  - PRODUCT PLANNING (Tony DiCenzo)
- **EUROPEAN PRODUCT LINE MANAGER (Dave Berry)**
- **MANUFACTURING BUSINESS MANAGER (Vin Maietta)**
  - PRODUCTION MANAGER (Joe Bernabeo)
  - MATERIALS MANAGER (Bruce Gordon)
- **LONG RANGE PLANNING (Pete Jenzen)**
  - PRODUCT PLANNING (Tony DiCenzo)

CORPORATE SOFTWARE SERVICES
ORGANIZATION CHART

- CORPORATE SOFTWARE SERVICES MANAGER (Bruno Durr)
  - CORPORATE OPERATIONS GROUP MANAGER (Haskell Cehrs)
    - MAYNARD SUPPORT GROUP (Henry Adleman)
    - MARLBORO SUPPORT GROUP (Clarke Wegner)
    - SOFTWARE SERVICES TRAINING GROUP (Nick Pappas)
    - ADMINISTRATIVE SERVICES GROUP (Angela Cossette)
    - MANAGEMENT INFORMATION SYSTEMS GROUP (Maureen Stretch)
  - NORTH AMERICAN AREA SOFTWARE SERVICES MANAGER (Sam Watson)
  - EUROPEAN AREA SOFTWARE SERVICES MANAGER (David Stone)
  - GENERAL INTERNATIONAL AREA SOFTWARE SERVICES MANAGER (Ken Brown)
  - SOFTWARE SERVICES MARKETING MANAGER (Hank Spencer)
  - SPECIAL PROJECTS (Bill Gamble)
  - FINANCIAL ANALYST (Randy Herald)

CUSTOMER SERVICES
ORGANIZATION CHART

VICE PRESIDENT CUSTOMER SERVICES (Jack Shields)

- **PRODUCT SUPPORT MANAGER (Don Busiek)**
  - NEW PRODUCTS OPTIONS MANAGER (Chris Ball)
  - NEW METHODS MANAGER (Steve Davis)
  - INDUSTRIAL SUPPORT MANAGER (Don Herbener Acting)
  - LDP, DDP, DCG, TELCO, PDP-15, BUS/WD PROCESS, IQR MANAGER (Mike Kalagher)
  - DECsystem-10/20 MANAGER (Walter Manter)
  - ALL OEM AND EDUCATION MANAGER (Frank Purcell)
  - RAMP MANAGER (Bob Swarz)
  - NEW PRODUCTS CPU/SYSTEMS MANAGER (Art Zins)
- **ADMINISTRATION MANAGER (Cliff Clarke)**
  - LOGISTICS MANAGER (Tom Karpowski)
  - CENTRAL ADMINISTRATION MANAGER
  - OPERATIONS DEVELOPMENT MANAGER (Farrell Woods)
  - TECHNICAL DOCUMENTATION MANAGER (Joe Santini)
    - MANAGER TECHNICAL WRITING (Jack Cromwell)
      - MARLBORO WRITING GROUP SUPERVISOR (Don Mehaffey)
      - MARLBORO LCG SUPERVISOR (George Berger)
      - MAYNARD WRITING GROUP SUPERVISOR (Jim Sullivan)
      - MAYNARD WRITING GROUP SUPERVISOR (Roy Clark)
      - MAYNARD WRITING GROUP SUPERVISOR (John Sullivan)
      - NEW HAMPSHIRE WRITING GROUP SUPERVISOR (Lee Butler)
    - MANAGER MICROPUBLISHING/DOCUMENTATION CONTROL (Dick Lennard)
      - MICROPUBLISHING SUPERVISOR (Bob Kruger)
    - MANAGER PRODUCTION SERVICES (Walter Stalter)
      - EDITING AND COMPOSITION MANAGER (Phil Kelley)
      - ILLUSTRATING MANAGER (Bob Walker)
      - PHOTOGRAPHY MANAGER (Lee Parks)
- **MARKETING MANAGER (Dave Denniston)**
  - MARKETING SERVICES MANAGER (Lynne Canal)
  - PRODUCT/MARKET PLANNING MANAGER (Doug Langenberg)
  - NATIONAL ACCOUNTS MANAGER (Tony Pensabene)
- **CUSTOMER SPARES MANAGER (Dave Dubay)**
  - MARKETING/SALES SUPPORT MANAGER (Will O'Brien)
  - MATERIALS MANAGER (Fred Laskey)
  - TECHNICAL SUPPORT MANAGER (John Misialek)

CUSTOMER SERVICES (Cont)
ORGANIZATION CHART

- EDUCATIONAL SERVICES MANAGER (Del Lippert)
  - NORAM MANAGER (Mike McKinon)
  - G.I.A. MANAGER (Pat Cataldo)
  - EUROPEAN MANAGER (Colin Allan)
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APPENDIX B
MNEMONIC LISTING

The following mnemonic listing reflects only those mnemonics used within this manual. Other listings have been produced and are available from the various organizations within the company. For example, Software and Advanced Systems (Software Development Orientation Guide), Manufacturing New Product Introduction (General New Product Start-up Plan) and CIS Information Handling Services (The CIS Jargon Book), to name a few, have generated similar listings in the listed documents.

MNEMONICS

ACT	Automated Computer Testing
ALGOL	Algorithmetic Language
ALM	Assembly Library Module
AMT	Automated Module Test
ANSI	American National Standards Institute
APT	Automated Product Test
ASCII	American Standard Code for Information Interchange
ASSIST-11	Directory Assistance System
AWT	Automatic Wire Tester
BASIC	Beginner's All-purpose Symbolic Instruction Code
BLISS	Programming Language
BOM	Bill of Materials
BUBBLES	Magnetic Memory for Computer Storage
BUS	Business
CAD	Computer Aided Design
CALDEC	Computer Aided Layout by DEC
CALMA	An Interactive Graphics System
CAM	Computer Aided Manufacturing
CCD	Charge Coupled Devices
CCITT	Comite' Consultatif Internationale de Telegraphie et Telephonie
CIS	Corporate Information Services
CMT	Computerized Module Test
COBOL	Common Business Oriented Language
CODASYL	Conference on Data Systems Languages
COM	Computer Output Microfilm
CPL	Cross Products Line
CSA	Canadian Standards Association
CSS	Computer Special Systems

DCG	Digital Components Group
DDP	Distributed Data Processing
DECnet	Software for building computer data communication networks
DECUS	Digital Equipment Computer Users Society
DIAMOND	Hybrid Performance Measurement System
DSN	Digital Software News
EBOD	Engineering Board of Directors
ECC	Error Correction Code
ECO	Engineering Change Order
EPG	Education Products Group
EPLS	Engineering Product Library System
ESE	European Software Engineering
ESG	Engineering Systems Group
E/OD	Employee/Organization Development
FA&T	Final Assembly and Test
FCO	Field Change Order
FCS	First Customer Ship
FDC	Factory Data Collection
FIPS	Federal Information Processing Standards
FORTRAN	Formula Translator
FSG	Federal Systems Group
GEMS	A semi-automated process of digitizing printed circuit layout
GIA	General International Area
GIS	Government Information Systems
HA/MP	High Availability/Multiprocessing
IC	Integrated Circuit
IDEA	Interactive Design and Engineering Analysis
IEC	International Electrotechnical Commission
IPC	Information Processing Center
IPG	Industrial Products Group
IPP	In-process Part
IPS	Information Processing Services
ISO	International Standards Organization
LCG	Large Computer Group
LDP	Laboratory Data Products
LQP	Letter Quality Printer
LR	Limited Release
LSI	Large Scale Integration
MACRO-10	Assembly Language for DECsystem-10/20
MACRO-11	Assembly Language for PDP-11
MC	Marketing Committee
MCB	M Communications Base – RSX-11M
MDP	Medical Data Products
MIF	Manufacturing Interface File
MIMIC	A major Simulation Language
MIS	Medical Information Systems
MPF	Master Parts File

MTBF	Mean-time Between Failure
MTTR	Mean-time To Repair
NC	Numerically Controlled
NCU	Network Control Utilities
NPSU	New Product Start Up
NSP	Network Services Protocol
OEM	Original Equipment Manufacturer
OOD	Office of Development
PCB	Printed Circuit Board
PG	Program Generated
PL	Product Line
PMT	Process Maturity Test
PNRF	Part Number Request Form
PPL	Purchased Parts List
PR	Production Release
PSG	Product Steering Group
QC	Quality Control
QVL	Qualified Vendor List
R&D	Research and Development
RAMP	Reliability and Maintainability Program
RAT	Review Action Team
RJE	Remote Job Entry
RSTS	Resource Sharing Timesharing System
RSTS/CIS	Commercial Instruction Set
RT/C	Real-Time/Computation
SAGE	Simulation of Asynchronous Gate Elements
SCAN	An automated system for retrieval of printed information
SDC	Software Distribution Center
SDP	Software Development Policy
SLIC	Simulator of Integrated Circuits
SPD	Software Product Descriptions
SPR	Software Performance Report
SQM	Software Quality Management
STUDD	Simulator and Tester Usage for Design and Diagnostics
SWS	Software Services
TMS-11/CMS-11	Typeset Management/Classified Management-11
TPL	Traditional Product Line
TPS	Transaction Processing Systems
TRS	Time Reporting Systems
UL	Underwriter's Laboratory
VCD	Variable Center Distance

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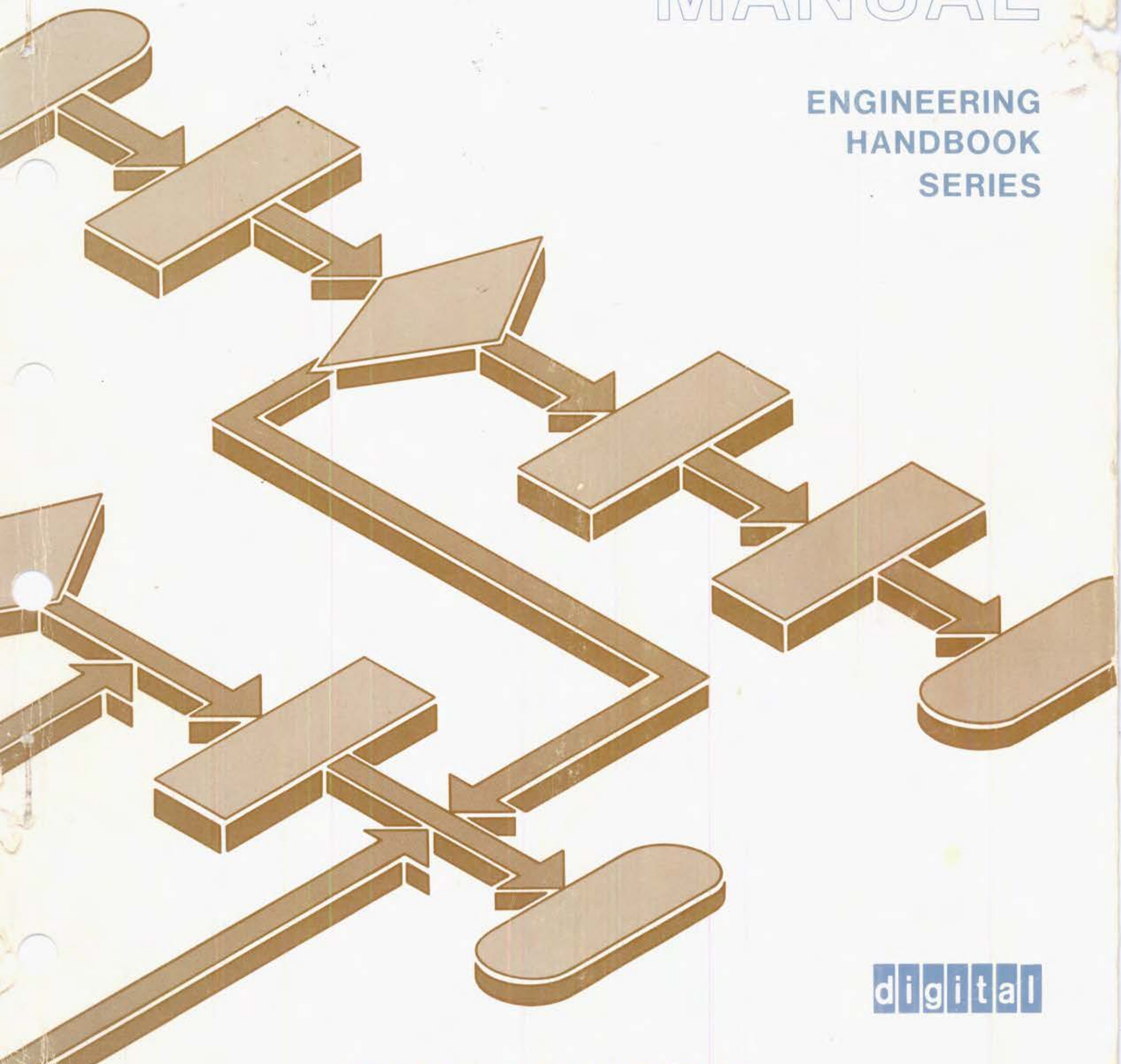

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(EB-ENGRS-OM-002)

ENGINEER'S ORIENTATION MANUAL

JANUARY, 1980
COMPANY CONFIDENTIAL

2nd Edition, January 1980

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· successes + failure

PREFACE

As a new employee at Digital, you will feel quickly at home if you have a clear statement of the philosophy and values we believe have made Digital not only an outstanding success in the computer industry, but also a good place to work. Our philosophy has shaped our "style" and the environment in which you will work.

We want the *highest quality products* in the industry. When you ask current or potential computer users, "Who makes the best computer systems?" we want the answer to be "Digital!"

We want *leadership products* in every Digital market – products that do the job for the user better than those available from any other supplier.

The foundation of our success is our knowledge of computer technology; we must always strive to increase that knowledge.

We turn our technology into products through people. We have, and want to continue to have, the *best people* in the industry. We hire the best and we work hard to maintain an environment that allows them to contribute their fullest potential. The key elements of this environment are:

- **Individual responsibility** – we depend upon our people to use their heads, to reach out for responsibility, to make decisions.

- **Open communication** – there are no barriers to effective communication between people at Digital. Organizational boundaries and titles are, as far as communication is concerned, irrelevant. We believe in total openness on all issues, that issues are best resolved by direct interaction between people, regardless of different organizations or different levels of responsibility.

- **Good ideas** – they come from everywhere. We believe that our managers should encourage and promote the creative ideas that bubble up from people in the organization.

In the last several years, Digital has scored number one as the most *ethical* computer company in the industry. This is no accident. We want to be completely honest and open with our customers. We want them to get their money's worth when they buy from us; we expect to meet all our commitments.

In short, having hired the best people in the industry and provided a rich environment for them, we expect extraordinary performance. Work hard, produce good products, reach beyond the normal requirements of your job, and above all, *use your head,* and both you and Digital will grow and prosper.

We are happy to have you with us. We hope you, too, will enjoy working at Digital.

Larry Portner
Vice President,
Associate Head of Engineering

FOREWORD

The following text is reprinted with permission from "The Unwritten Laws of Engineering" by W.J. King, originally appearing in the May, June, and July 1944 issues of *Mechanical Engineering*. That the article has been reprinted several times during the last 36 years should bear witness to its usefulness. It offers much wisdom to young engineers starting their careers, and to older engineers who know these things perfectly well but who all too often fail to apply them in practice.

IN RELATION TO YOUR WORK

However menial and trivial your early assignments may appear give them your best efforts. Many young engineers feel that the minor chores of a technical project are beneath their dignity and unworthy of their college training. They expect to prove their true worth in some major enterprise. Actually, the spirit and effectiveness with which you tackle your first humble tasks will very likely be carefully watched and may affect your entire career.

Occasionally you will worry unduly about where your job is going to get you – whether it is sufficiently strategic or significant. Of course these are pertinent considerations and you would do well to take stock of them, but by and large it is fundamentally true that if you take care of your present job well, the future will take care of itself. This is particulary so in the case of a large corporation, where executives are constantly searching for competent people to move up into more responsible positions. Success depends so largely upon personality, native ability, and vigorous, intelligent prosecution of any job that it is no exaggeration to say that your ultimate chances are much better if you do a good job on some minor detail than if you do a mediocre job as section head. Furthermore, it is also true that if you do not at first make a good showing on your present job you are not likely to be given the opportunity of trying something else more to your liking.

There is always a premium upon the ability to get things done. This is a quality which may be achieved by various means under different circumstances. Specific aspects will be elaborated in some of the succeeding items. It can probably be reduced, however, to a combination of three basic characteristics:

(a) Energy, which is expressed in initiative to start things and aggressiveness to keep them moving briskly.

(b) Resourcefulness or ingenuity, i.e., the faculty for finding ways to accomplish the desired result, and

(c) Persistence (tenacity), which is the disposition to persevere in spite of difficulties, discouragement, or indifference.

This last quality is sometimes lacking in the make-up of brilliant engineers, to such an extent that their effectiveness is greatly reduced. Such dilettantes are known as "good starters but poor finishers." Or else it will be said of a man (or a woman): "You can't take him too seriously; he'll be all steamed up over an idea today but tomorrow he will have dropped it and started chasing some other rainbow." Bear in mind, therefore, that it may be worth while finishing a job, if it has any merit, just for the sake of finishing it.

In carrying out a project, do not wait for managers, vendors, and others to deliver the goods; go after them and keep after them. This is one of the first things a new engineer has to learn in entering a manufacturing organization. Many novices assume that it is sufficient to place the order and sit back and wait until the goods are delivered. The fact is that most jobs move in direct proportion to the amount of follow-up and expediting that is applied to them. Expediting means planning, investigating, promoting, and facilitating every step of the process. Cultivate the habit of looking immediately for some way around each obstacle encountered, some other recourse or expedient to keep the job rolling without losing momentum. There are ten-to-one differences between individuals in respect to what it takes to stop their drive when they set out to get something done.

On the other hand, the matter is occasionally overdone by overzealous individuals who make themselves obnoxious and antagonize everyone by their offensive browbeating tactics. Be careful about demanding action from another department. Too much insistence and agitation may result in more damage to your personal interests than could ever result from the miscarriage of the technical point involved.

Confirm your instructions and the other person's commitments in writing. Do not assume that the job will be done or bargain kept just because the other person agreed to it. Many people have poor memories, others are too busy, and almost everyone will take the matter a great deal more seriously if he or she sees it in writing. Of course there are exceptions, but at times it pays to mark a third party for a copy of the memo, as a witness.

When sent out on any complaint or other assignment stick with it and see it through to a successful finish. All too often a young engineer from the home office will leave a job half done or poorly done in order to catch a train or keep some other engagement. Wire the boss that you've got to stay over to clean up the job. Neither the boss nor the customer will like it if another person has to be sent out later to finish it up.

Avoid the very appearance of vacillation. One of the gravest indictments of an engineer is to say: "His or her opinion at any time depends merely upon the last person with whom he or she has talked." Refrain from stating an opinion or promoting an undertaking until you have had a reasonable opportunity to obtain and study the facts. Thereafter see it through if at all possible, until fresh evidence makes it folly to persist. Obviously the extremes of bullheadedness and dogmatism should be avoided, but remember that reversed decisions will be held against you.

Don't be timid – speak up – express yourself and promote your ideas. Every young engineer should read Emerson's essay on "Self Reliance." Too many new people seem to think that their job is simply to do what they're told to do, along the lines laid down by the boss. Of course there are times when it is very wise and prudent to keep your mouth shut, but, as a rule, it pays to express your point of view whenever you can contribute something. The quiet mousey individual who says nothing is usually credited with having nothing to say.

It frequently happens in any sort of undertaking that nobody is sure of just how the matter ought to be handled; it's a question of selecting some kind of program with a reasonable chance of success. This is commonly to be observed in engineering meetings. The first person to speak up with a definite and plausible proposal has better than an even chance of carrying the floor, provided only that the scheme is definite and plausible. (The "best" scheme usually cannot be recognized as such in advance.) It also happens that the person who talks most knowingly and confidently about the matter will very often end up with the assignment to carry out the project. If you do not want the job, keep your mouth shut and you'll be overlookeded, but you'll also be overlooked when it comes time to assign larger responsibilities.

Before asking for approval of any major action, have a definite plan and program worked out to support it. Executives very generally and very properly will refuse to approve any proposed undertaking that is not well planned and thought through as regards the practical details of its execution. Quite often a young person will propose a project without having worked out the means of accomplishing it, or weighing the actual advantages against the difficulties and costs. This is the difference between a "well-considered" and a "half-baked" scheme.

Strive for conciseness and clarity in oral and written reports. If there is one bane of an executive's existence, it is the person who takes a half hour of rambling discourse to tell what could be said in a sentence of twenty words. There is a curious and wide-spread tendency among engineers to surround the answer to a simple question with so many preliminaries and commentaries that the answer itself can hardly be discerned. It is so difficult to get a direct answer out of some people that their usefulness is greatly diminished. The tendency is to explain the answer before answering the question. To be sure, very few questions admit of simple answers without qualifications, but the important thing is to state the crux of the matter as succinctly as possible first. On the other hand, there are times when it is very important to add the pertinent background or other relevant facts to illuminate a simple statement. The trick is to convey the maximum of significant information in the minimum time, a valuable asset to anyone.

An excellent guide in this respect may be found in the standard practice of newspapers in printing the news. The headlines give you 90% of the basic facts. If you have the time and interest to read further, the first paragraph will give you most of the important particulars. Succeeding paragraphs simply give details of progressively diminishing significance. To fit an article into available space, the editor simply lops off paragraphs at the rear end, knowing that relatively little of importance will be lost. You can hardly do better than to adopt this method in your own reports, presenting your facts in the order of importance, as if you might be cut off any minute.

Be extremely careful of the accuracy of your statements. This seems almost trite, and yet many engineers lose the confidence of their superiors and associates by habitually guessing when they do not know the answer to a direct question. It is certainly important to be able to answer questions concerning your responsibilities, but a wrong answer is worse than no answer. If you do not know, say so, but also say, "I'll find out right away." If you are not certain, indicate the exact degree of certainty or approximation upon which your answer is based. A reputation for dependability and reliability can be one of your most valuable assets.

This applies, of course, to written matter, calculations, etc., as well as to oral reports. It is definitely bad business to submit a report to the boss for approval without first carefully checking it yourself, and yet formal reports are sometimes turned in full of glaring errors and omissions.

IN RELATION TO THE BOSS

Every manager must know what's going on in his or her bailiwick. This principle is so elementary and fundamental as to be axiomatic. It follows from the very obvious fact that a person cannot possibly manage his or her business successfully unless he or she knows what's going on in it. It applies to minor managers and other individuals charged with specific responsibilities as well as to department heads. No one in his or her right mind will deny the soundness of the principle and yet it is very commonly violated or overlooked. It is cited here because several of the rules which follow are concerned with specific violations of this cardinal requirement.

Do not overlook the fact that you're working for your boss. This sounds simple enough, but some engineers never get it. By all means, you're working for society, the company, the department, your family, and yourself, but primarily you should be working for and through your boss. And your boss is your immediate superior, to whom you report directly. It is not uncommon for young engineers, in their impatient zeal to get things done, to ignore the boss, or attempt to go over or around the boss. Sometimes they move a little faster that way, for a while, but sooner or later they find that such tactics cannot be tolerated in a large organization. Generally speaking, you cannot get by the boss; he or she determines your rating and rates you on your ability to cooperate, among other things. Besides, most of us get more satisfaction out of our jobs when we're able to give the boss our personal loyalty, with the feeling that we're helping him or her to get the main job done.

Be as particular as you can in the selection of your boss. In its effect upon your engineering career, this is second in importance only to the selection of proper parents. In most engineering organizations the influence of the senior engineer, or even the section head, is a major factor in molding the professional character of younger engineers. Long before the days of universities and textbooks, master craftsmen in all the arts absorbed their skills by apprenticeship to master craftsmen. It is very much as in the game of golf; a beginner who constantly plays in company with "duds" is very apt to remain a "dud," too, no matter how faithfully the rules are studied. Whereas even a few rounds with a "pro" will usually improve a novice's game.

But of course, it is not always possible to choose your boss advisedly. What if he or she turns out to be somewhat less than half the person he or she ought to be? There are only two proper alternatives open to you; (a) accept the boss as a representative of a higher authority and execute his or her policies and directives as effectively as possible, or (b) transfer to some other outfit at the first opportunity. A great deal of mischief can be done to the interests of all concerned (including the company) if some other alternative is elected, particularly in the case of younger persons. Consider the damage to the efficiency of a military unit when the privates, disliking the leader, ignore or modify orders to suit their individual notions. To be sure, a business organization is not a military machine, but it is not a mob either.

One of the first things your owe your boss is to keep him or her informed of all significant developments. This is a corollary of the preceding rules: A manager must know what's going on. The main question is: How much must he or she know – how many of the details? This is always a difficult matter for the new engineer to get straight. Many novices hesitate to bother the boss with too many reports, and it is certainly true that it can be overdone in this direction, but in by far the majority of cases the executive's problem is to extract enough information to be kept adequately posted. For every time the boss has to say, "Don't bother me with so many details," there will be three times he or she will say, "Why doesn't someone tell me these things?" Bear in mind that the boss is constantly called upon to account for, defend, and explain your activities to the "higher-ups," as well as to coordinate these activities into a larger plan. In a nutshell, the rule is therefore to give him or her all the information needed for these two purposes.

Whatever the boss wants done takes top priority. You may think you have more important things to do first, but unless you obtain permission it is usually unwise to put any other project ahead of a specific assignment from your own boss. As a rule, he or she has good reasons for wanting his or her job done *now*, and it is apt to have a great deal more bearing upon your rating than less conspicuous projects which may appear more urgent.

Also, make note of this: If you are instructed to do something and you subsequently decide it isn't worth doing (in view of the data or events) do not just let it die, but inform the boss of your intentions and reasons. Neglect of this point has caused trouble on more than one occasion.

Do not be too anxious to follow the boss's lead. This is another side of the matter covered by the preceding rule. An undue subservience or deference to the department head's wishes is fairly common among young engineers. A person with this kind of psychology may:

1. Plague the boss incessantly for minute directions and approvals.
2. Surrender all initiative and depend upon the boss to do all of his or her basic thinking.
3. Persist in carrying through a design or a program even after new evidence has proved the original plan to be wrong.

This is where an engineering organization differs from an army. In general, the program laid down by the department or section head is tentative, rather than sacred, and is intended to serve only until a better program is proposed and approved.

The rule therefore is to tell your boss what you have done, at reasonable intervals, and ask for approval of any well-considered and properly planned deviations or new projects that you may have conceived.

REGARDING RELATIONS WITH ASSOCIATES AND OUTSIDERS

In all transactions be careful to "deal-in" everyone who has a right to be in. It is extremely easy, in a large organization, to overlook the interests of some division or individual who does not happen to be represented, or in mind, when a significant step is taken. Very often the result is that the step has to be retracted or else considerable damage is done. Even when it does no apparent harm, most people do not like to be left out when they have a stake in the matter, and the effect upon morale may be serious.

Of course there will be times when you cannot wait to stand on ceremony and you'll have to go ahead and "damn the torpedoes." But you cannot do it with impunity too often.

Note particularly that in this and the preceding item the chief offense lies in the invasion of the other person's territory without his or her knowledge and consent. You may find it expedient on occasions to do the other person's job in order to get your own work done, but you should first give the other person a fair chance to deliver the goods or else agree to have you take over. If you must offend in this respect, at least you should realize that you are being offensive.

Be careful about whom you mark for copies of letters, memos, etc., when the interests of other departments are involved. A lot of mischief has been caused by young people broadcasting memoranda containing damaging or embarrassing statements. Of course it is sometimes difficult for a novice to recognize the "dynamite" in such a document but, in general, it is apt to cause trouble if it steps too heavily upon someone's toes or reveals a serious shortcoming on anybody's part. If it has wide distribution or if it concerns manufacturing or customer difficulties, you'd better get the boss to approve it before it goes out unless you're very sure of your ground.

Promises, schedules, and estimates are necessary and important instruments in a well-ordered business. Many engineers fail to realize this, or habitually try to dodge the irksome responsibility for making commitments. You must take promises based upon your own estimates for the part of the job for which you are responsible, together with estimates obtained from contributing departments for their parts. No one should be allowed to avoid the issue by the old formula, "I can't give a promise because it depends upon so many uncertain factors." Consider the "uncertain factors" confronting a department head who must make up a budget for an entire engineering department for a year in advance! Even the most uncertain case can be narrowed down by first asking, "Will it be done in a matter of a few hours or a few months – a few days or a few weeks?" It usually turns out that it cannot be done in less than three weeks and surely will not require more than five, in which case you'd better say four weeks. This allows one week for contingencies and sets you a reasonable bogie under the comfortable figure of five weeks. Both extremes are bad; a good engineer will set schedules which can be met by energetic effort at a pace commensurate with the significance of the job.

As a corollary of the following, you have a right to insist upon having estimates from responsible representatives of other departments. But in accepting promises, or statements of facts, it is frequently important to make sure you are dealing with a qualified representative of the other section. Also bear in mind that when you ignore or discount another person's promises you impugn his or her responsibility and incur the extra liability yourself. Of course this is sometimes necessary, but be sure that you do it advisedly. Ideally, another person's promises should be negotiable instruments, like a personal check, in compiling estimates.

When you are dissatisfied with the services of another section, make your complaint to the individual most directly responsible for the function involved. Complaints made to a person's superiors, over the person's head, engender strong resentments and should be resorted to only when direct appeal fails. In many cases such complaints are made without giving the person a fair chance to correct the grievance, or even before he or she is aware of any dissatisfaction.

This applies particularly to individuals with whom you are accustomed to dealing directly or at close range, or in cases where you know the person to whom the function has been assigned. It is more formal and in some instances possibly more correct to file a complaint with the head of the section or department, and it will no doubt tend to secure prompt results. But there are more than a few individuals who would never forgive you for complaining to their boss without giving them a fair chance to take care of the matter.

In dealing with customers and outsiders remember that you represent the company, ostensibly with full responsibility and authority. You may be only a few months out of college but most outsiders will regard you as a legal, financial, and technical agent of your company in all transactions, so be careful of your commitments.

PURELY PERSONAL CONSIDERATIONS FOR ENGINEERS

About 99% of the emphasis in the training of engineers is placed upon purely technical or formal education. In recent years, however, there has been a rapidly growing appreciation of the importance of "human engineering," not only in respect to relations between management and employees but also as regards the personal effectiveness of the individual worker, technical or otherwise. It should be obvious enough that a highly trained technological expert with a good character and personality is necessarily a better engineer and a great deal more valuable to his or her company than a sociological freak or misfit with the same technical training. This is largely a consequence of the elementary fact that in a normal organization no individual can get very far in accomplishing any worth-while objectives without the voluntary cooperation of his or her associates. And the quantity and quality of such cooperation is determined by the "personality factor" more than anything else.

This subject of personality and character is, of course, very broad and much has been written and preached about it from social, ethical, and religious points of view. The following "laws" are drawn from the purely practical point of view based upon well-established principles of "good engineering practice," or upon consistently repeated experience. As in the preceding sections, the selections are limited to rules which are frequently violated, with unfortunate results, however obvious or bromidic they may appear.

"LAWS" OF CHARACTER AND PERSONALITY

One of the most important personal traits is the ability to get along with all kinds of people. This is rather a comprehensive quality but it defines the prime requisite of personality in any type of industrial organization. No doubt this ability can be achieved by various formulas, although it is probably based mostly upon general, good-natured friendliness, together with fairly consistent observance of the "Golden Rule." The following "do's and don'ts" are more specific elements of such a formula:

1. Cultivate the tendency to appreciate the good qualities, rather than the shortcomings of each individual.

2. Do not give vent to impatience or annoyance on slight provocation. Some offensive individuals seem to develop a striking capacity for becoming annoyed, which they indulge with little or no restraint.

3. Do not harbor grudges after disagreements involving honest differences of opinion. Keep your arguments on an objective basis and leave personalities out as much as possible.

4. Form the habit of considering the feelings and habits of others.

5. Do not become unduly preoccupied with your own selfish interests. It may be natural enough to "look out for Number One first," but when you do your associates will leave the matter entirely in your hands, whereas they will be much readier to defend your interests for you if you characteristically neglect them for unselfish reasons.

   This applies particularly to the matter of credit for accomplishments. It is much wiser to give your principal attention to the matter of getting the job done, or to building up your people, than to spend too much time pushing your personal interests ahead of everything else. You need have no fear of being overlooked; about the only way to lose credit for a creditable job is to grab for it too avidly.

6. Make it a rule to help the other fellow when the opportunity rises. Even if you're mean-spirited enough to derive no satisfaction from accommodating others it's a good investment. The business world demands and expects cooperation and teamwork among the members of an organization. It's smarter and pleasanter to give it freely and ungrudgingly, up to the point of unduly neglecting your responsibilities.

7. Be particularly careful to be fair on all occasions. This means a good deal more than just being fair, upon demand. All of us are frequently unfair, unintentionally, simply because we do not habitually view the matter from the other person's point of view, to be sure that his or her interests are fairly protected. For example, when a person fails to carry out an assignment, he or she is sometimes unjustly criticized when the real fault lies with the manager who failed to give him or her the tools to do the job. Whenever you enjoy some natural advantage, or whenever you are in a position to injure someone seriously, it is especially incumbent upon you to "lean over backwards" to be fair and square.

8. Do not take yourself or your work too seriously. A normal healthy sense of humor, under reasonable control, is much more becoming, even to an executive, than a chronically soured dead-pan, a perpetually unrelieved air of deadly seriousness, or the pompous solemn dignity of a stuffed owl. It is much better for your blood pressure, and for the morale of the office, to laugh off an awkward situation now and then than to maintain a tense tragic atmosphere of stark disaster when ever matters take an embarrassing turn. To be sure, a serious matter should be taken seriously, and a person should maintain a quiet dignity as a rule, but it does more harm than good to preserve an oppressively heavy and funereal atmosphere around you.

9. Put yourself out just a little to be genuinely cordial in meeting people. True cordiality is, of course, spontaneous and should never be affected, but neither should it be inhibited. We all know people who invariably pass us in the hall or encounter us elsewhere without a shadow of recognition. Whether this be due to inhibition or preoccupation we cannot help feeling that such unsociable chumps would not be missed much if we never saw them again. On the other hand it is difficult to think of anyone who is too cordial, although it can doubtless be overdone like anything else. It appears that most people tend naturally to be sufficiently reserved or else overreserved in this respect.

10. Give other people the benefit of the doubt if you are inclined to suspect their motives, especially when you can afford to do so. Mutual distrust and suspicion breed a great deal of absolutely unnecessary friction and trouble, frequently of a very serious nature. This is a very common phenomenon that can be observed among all classes and types of people, in

international as well as local affairs. It is derived chiefly from misunderstandings, pure ignorance, or from an ungenerous tendency to assume that a person is guilty until proved innocent. No doubt the latter assumption is the "safer" bet, but it is also true that if you treat others as depraved scoundrels, they will usually treat you likewise, and they will probably try to live down to what is expected of them.

Regard your personal integrity as one of your most important assets. In the long pull there is hardly anything more important to you than your own self-respect and this alone should provide ample incentive to maintain the highest standard of ethics of which you are capable. But, apart from all considerations of ethics and morals, there are perfectly sound hardheaded business reasons for conscientiously guarding the integrity of your character.

One of the most striking phenomena of an engineering office is the transparency of character among the members of any group who have been associated for any length of time. In a surprisingly short period each individual is recognized, appraised, and catalogued for exactly what he or she is, with far greater accuracy than that individual usually realizes. This is true to such a degree that it makes people appear downright ludicrous when they assume a pose or otherwise try to convince us that they are something better than they are. As Emerson puts it: "What you are speaks so loud I cannot hear what you say." In fact, it frequently happens that people are much better known and understood by their associates, collectively, than they know and understand themselves.

Therefore, it behooves you as an engineer to let your personal conduct, overtly and covertly, represent your conception of the very best practical standard of professional ethics, by which you are willing to let the world judge and rate you.

Moreover, it is morally healthy and tends to create a better atmosphere, if you will credit the other fellow with similar ethical standards, even though you may be imposed upon occasionally. The obsessing and overpowering fear of being cheated is the common characteristic of second- and third-rate personalities. This sort of psychology sometimes leads a person to assume an extremely "cagey" sophisticated attitude crediting him or herself with being impressively clever when he or she is simply taking advantage of his or her more considerate and fairminded associates. On the other hand a substantial majority of top-flight executives are scrupulously fair, square, and straightforward in their dealings with all parties. In fact most of them are where they are largely because of this characteristic, which is one of the prime requisites of first-rate leadership.

The priceless and inevitable reward for uncompromising integrity is confidence, the confidence of associates, subordinates, and "outsiders." Confidence is such an invaluable business asset that even a moderate amount of it will easily outweigh any temporary advantage that might be gained by sharp practices.

Integrity of character is closely associated with sincerity, which is another extremely important quality. Obvious and marked sincerity is frequently a source of exceptional strength and influence in certain individuals, particularly in the case of speakers. Abraham Lincoln is a classic example. In any individual, sincerity is always appreciated, and insincerity is quickly detected and discounted.

In order to avoid any misunderstanding, it should be granted here that the average person, and certainly the average engineer, is by no means a low dishonest scoundrel. In fact, the average person would violently protest any questioning of his or her essential honesty and decency, perhaps fairly enough. But there is no premium upon this kind of common garden variety of honesty, which is always ready to compromise in a pinch. The average person will go off the gold standard or compromise with any sort of expediency whenever it becomes moderately uncomfortable to live up to his or her obligations. This is hardly what is meant by "integrity", and it is certainly difficult to base even a moderate degree of confidence upon the guarantee that you will not be cheated unless the going gets rough.

Finally, it should be observed that the various principles which have been expounded, like those of the arts and sciences, must be assiduously applied and developed in practice if they are to become really effective assets. It is much easier to recognize the validity of these "laws" than it is to apply them consistently. The important thing here is to select, in so far as possible, a favorable atmosphere for the development of these professional skills. This is undoubtedly one of the major advantages of employment in a large engineering organization. Perhaps, even more important, as previously mentioned, is the selection of your boss, particularly during those first few years that constitute your engineering apprenticeship. No amount of precept is as effective as the proper kind of example. Unfortunately, there is not nearly enough of this kind of example to go around, and in any event it will behoove you to study the "rules of the game" to develop your own set of principles to guide you in your professional practice.

SECTION 1

CORPORATE OVERVIEW

1.0 SCOPE

Orientation means to familiarize with or adjust to a new situation; it also means to align or position with respect to a specific direction or reference system. Section 1 helps you become familiar with Digital Equipment Corporation in four ways. First, Ken Olsen, founder and president of Digital, relates Digital's own brand of philosophic autonomy in the areas of communication, compromise, and cooperation. Second, a short history of the company's achievements is provided. Next, "Digital Philosophy" provides you with positive, growth-producing values inherent to the operation of the company. Finally, Digital's management style and structure are broadly outlined. These topics in Section 1 provide you with a perspective by which you may meld your personal goals with those of the corporation to grow and prosper.

2.0 INTRODUCTION - KEN OLSEN

Before you select specific sections to read that may be of immediate interest to you, take a few minutes to read the following excerpts from a speech given by Ken Olsen to an engineering group.

> "Don't communicate with neighbors in your community about company matters; there is just too much information about what we do at Digital that reaches people outside the corporation. Sometimes we don't fully appreciate the importance of keeping our mouth shut because any one thing doesn't look all that significant. But altogether, things are really important. Any time we, as a company are so open and talk about company matters, we invest heavily in communication.
>
> "Everything is a compromise and we ought to consider every decision we make as a meaningful compromise. The whole art of engineering is compromise. Therefore, engineers of all people should be best at compromising. Often, however, they have the worst time in making compromises. You can't build a bridge, or an airplane, or a computer that's absolutely safe in every alternative. It would take forever, cost an infinite amount of money, and there wouldn't be enough weight left for cars on the bridge, you couldn't get off the ground in the airplane, and you couldn't meet your schedule.

"There is no absolute safety. We're professionals, we can't get away with saying 'I will go all the way, one way and be safe'. We must find the best compromise and then live with the ensuing criticisms. We just learn by our mistakes and do better. That's what we're paid for in our profession. There is a list of things in which we must compromise and identifying them, I think, will help us face the issue.

"The first area of compromise is in new technology. The only time we claim that we've ever been ahead of technology is the day we opened our doors and we've been behind ever since. There are a number of reasons for this. When we started, we had a handful of technology. After that we had to live with our previous product and with our customers who dictated what they wanted. In general, they didn't care about technology. They wanted the products to continue, they had problems to solve and that is what they were interested in. Compromises come because in the long run they use technology that gives the best product, the best solution to problems, the lowest price, and the best reliability. We must always face that.

"A few years ago, the world was promising great things in integrated circuits. The professors at MIT were promising then what we can just do today and the world hated us because we said it wasn't ready yet. We were the last ones to use integrated circuits, and then we were 6 months early! The argument that showed we were right said that we paid 60 cents per unit while others paid 4 dollars per unit because they started earlier than we did and their product was therefore that much more expensive.

"A few years ago, one of our development managers was very excited about magnetic bubbles. 'You can't lose' he said. 'We must jump on the bandwagon; we must be a leader or we'll lose out.' Even Gordon Bell said it was coming soon. We were reluctant to offend that development manager because he was so enthusiastic, but we said 'no'. Well, five years later, it doesn't look like we've lost all that much. Waiting until we're sure has been a good policy. On the other hand, you can't survive by saying 'no' to all new technology.

"The second area of compromise is merely red tape which includes scheduling and budgeting. Our engineering departments terrify me because I think we're training hundreds of people to be budgeters and schedulers and after awhile they'll all forget how to be engineers. Budgets and schedules are tools; they are not used instead of engineering. We've got to use them but that's all they are, just tools. We are engineers, and we are only useful as long as we're doing engineering.

"A third area of compromise is safety. There are many things that fail for which there is no excuse. We just really work to cover all the alternatives. Products shouldn't fail. In some areas there is no excuse for failure; the compromise comes in because you can't make everything absolutely safe.

"In engineering there are no excuses. It has to work. I sat at IBM for a year, which was the worst year of my life. I didn't have much to do, but I learned a lot there. I was representing MIT and the Air Force and I had to make certain the products were done right. I could nail them because they didn't have technical analyses on the steel racks, but I couldn't tell them to start at the joints because that wasn't in the requirements. I decided that all the people there were really making a list of reasons that if any failures occurred it wasn't their fault.

"We can't do that! We have to get the job done, make sure it succeeds and realize there is always some chance of failure. We mustn't make a list of reasons to show that if something goes wrong it wasn't our fault. When we schedule projects, the normal tendency of an engineer is to schedule the test point two years away; postpone the day of failure for two years. That's just not healthy. I have often thought I wouldn't hire my son at Digital. I think if I did I would have him go into our Computer Special Systems organization because they succeed or fail every month and learn from it. We should make all our mistakes easy ones, our failures small and have them come early, so we can learn.

"The fourth area of compromise that I worry about in modern engineering is the amount of time that people spend preparing presentations for marketeers (when they're not budgeting or scheduling). Let me tell you how it looks to an outsider. A group of engineers studies something, they think about it for months and they look at it from every angle. They know as much as can be known. They know exactly which way to go. But, either because they are cowardly and want someone else to take the responsibility for their decision, or for some mysterious reason I can't explain, they make massive presentations to marketing people and lay the question before them. Now the marketeers have never thought about the subject before. When engineers ask them for a point of view they get back from 100 people 100 points of view that become 1,000 points of view before the meeting is over. Because engineers have a project on which they don't want to do engineering, they'll work two years budgeting and scheduling, they won't do any work, won't read a magazine, won't look at a book, nor a catalogue and won't draw up our diagrams; because they won't do any real work until they have this 'buy-in' from marketeers.

"Another area of compromise comes in discipline. We follow sort of the New England tradition of revolutionary soldiers. We look and behave like rebels. We think we won the Revolution because the British soldiers marched in straight rows, fired their muskets in unison and never aimed, while the smart Americans fired at random from behind trees and stone walls. The real story is that whenever the British started shooting back, the Americans just ran. The whole fight that we're so proud of in Concord was one big mistake. The Americans were so undisciplined and disorganized they got the whole thing started by mistake. The Colonial rebels really didn't win until they hired some European officers who taught them how to march in straight rows, shoot on command, and stand their ground when the other side shot back. When they finally got discipline, they won the war.

"You can take all these great stories on discipline with a grain of salt. Complete discipline would be too much of course. It's a compromise. No discipline whatsoever and there's never any production at all. We have to have discipline in our organization, our lives, our way of doing things. Compromise comes in because too much, by definition, is too much.

"Another area of compromise is in management. Managers must always compromise. They can go to extremes. One extreme is to do it all themselves. The problem with this is that we can't get them to do anything right, because the projects have to stay small so they can do everything themselves. It frustrates the people working for them. It frustrates the boss. Nothing happens until he gets around to it. He's not a manager at all. The other kind of manager who maybe is even worse, abandons everything. Between these extremes comes the compromise. Managing is playing that compromise. The manager must realize this and always face it. There are all kinds of tricks you can use to help. One is to require people to schedule all their work and then submit reports. The preparation of these reports will, in fact, force people to comply and review the information they need to do their job. When something falls apart, you know it and can talk to the people who are in trouble. Engineering sometimes takes forever, but it always comes out. Those things we watch get done, and those we don't watch never get done. It's one of the tricks. Another trick to managing is to threaten people that you might do the job better than they.

"I had lunch with the editor of one of Boston's big newpapers and had been critical of him. As we were walking out he asked, 'Do you ever have trouble motivating these 30-35 year old people?' I said, 'Our trouble is we can't get them to go home!' My frustration with that newspaper is that the reporters don't know what they are doing. They report freely but don't know what they are writing about. I figured out what that editor should do. If he would say, 'Let it be known that every month I am going to become an expert on a new subject' but not tell anybody what those things were, it would change the whole organization.

"We used to work for Jay Forrester, one of the real pioneers in computers. We called his style pulse management. He would come in with one pulse. Pulse management can keep people on their toes because they can't ever tell when you're going to come down and pulse them and know more than they do. It keeps the whole outfit sharp! They had better be awake!

"The other area in working out this compromise is to delegate. Of course you can't abandon a project either or nothing happens. One technique is to read a little about warfare. If you are an officer charged with defending a position, you go by every hour and check every single machine gun and the troops manning them. You make sure your men are not dead, that they're not sleeping, or sick; that they haven't run away. You make sure they're ready every hour. There is no such thing as losing the position and then saying, 'Well, things seemed okay when I checked yesterday'. When you're a manager, you have to manage so that you know everything that is going on. There is no such thing as, 'I trusted so and so and he let me down'.

"What happens to middle-aged people? In general, they want to get into management. Engineers want to retire from engineering. I think maybe society has forced us into doing that, and engineers ought to fight it. It's okay to be a manager; the company depends upon the availability of good managers. But we should never become managers because we want to 'retire' and get an easy job. There are no easy jobs. You ought to fight the temptation to retire and always take the hard jobs. Always work hard at it and when you become 40 or 50 you'll be in demand. During the last recession, many people in Massachusetts who were 45 and 50 were looking for jobs. They thought they couldn't find work because they were too old. I interviewed a number of them and consistently they said that they used to be engineers, or draftsmen, or machinists. But they got promoted into some administrative work for which they were paid very well. But now they couldn't find work. The secret of it, I think, is always to be something. Don't be a nothing. Be in demand. The interesting thing is that our society wants us to be promoted into a do-nothing administrative job. Be someone who's been something for 45 years and work hard at being GOOD at what you do."

3.0 FACTS ABOUT DIGITAL

Digital Equipment Corporation is the world's leading manufacturer of minicomputers, with over 150,000 computer installations. Digital is a leader in timesharing and interactive computing, and the foremost maker of logic modules. A Fortune 500 company, Digital employs more than 42,000 people worldwide. Digital's growth can be attributed to its continuing commitment to provide increased performance at a lower price.

Since the company's beginning in 1957, the commitment has been good for Digital and good for its customers. Digital's first computer, the PDP-1, broke the million dollar barrier in 1960, providing interactive computing capability for about $125,000. Digital's first minicomputer, the PDP-5, lowered the cost of interactive computing to about $25,000. (Its current day equivalent costs less than $2000!)

Digital's computer systems revolve around four central processor families:

- The PDP-8 was first used as a laboratory tool. Today, it functions in machine control, real-time monitoring applications, process control, and a host of business and commercial applications.

- The PDP-11 brought new technological advances to small computers. Compatible with processors from the LSI-11 to the PDP-11/70, it encompasses the broadest range of peripherals and software ever offered. These systems are used for everything from running a lathe to running a railroad.

- The DECsystem-10 was the first commercially available timesharing system designed to simultaneously handle timesharing, batch, remote job entry, and real-time tasks. DECsystem-10s are used by more data service companies to provide timesharing services than any other system. The DECSYSTEM-20, a smaller version of our large computer capability, bridges the gap between the DECsystem-10 and the PDP-11.

- VAX-11/780 is a multiuser, multilanguage, multiprogramming, high-performance computer system. The system combines a 32-bit architecture, a virtual memory operating system, and efficient memory management to provide essentially unlimited program space.

To support this line of processors, Digital manufactures a full line of peripheral equipment including disk and tape systems, input/output devices, hard copy and video terminals, and communication interfaces. This large selection of peripheral equipment allows Digital customers to tailor systems to meet today's specific needs, with the assurance of expansion capability for tomorrow's requirements.

Complementing the hardware offering, Digital provides software products such as application packages, operating systems, higher level languages, and utilities. These products bring the full capability to meet its commitment of increased performance at a lower price.

Possibly more important, Digital provides resources and services to support all of its products:

- Software support services which range from getting a specialized system up and running to writing a customized application program.
- A Field Service organization of more than 6,000 engineers worldwide who are available to service and perform preventive maintenance on all Digital computer systems.
- Sales, Software Support, and Field Service representatives provide sales and service from more than 360 locations in the U.S. and 35 foreign countries.
- Over 100 computer related courses are available to all Digital customers at worldwide training centers.
- DECUS, the Digital Equipment Computer Users Society, the largest such group in the world, sponsors symposia, publishes newsletters, and administers a program library for its members.

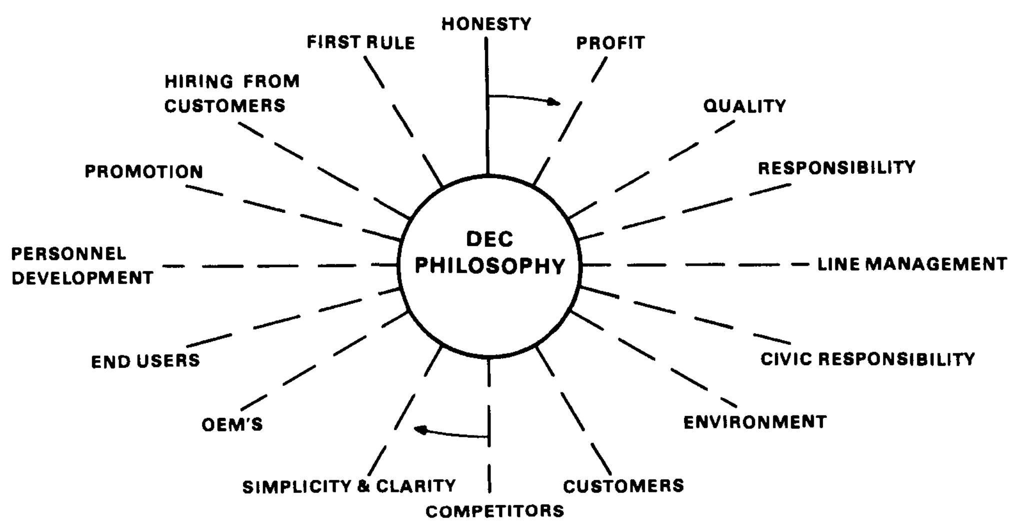

Figure 1-1 Digital Philosophy

4.0 DIGITAL PHILOSOPHY

Digital philosophy as represented by the following statements reflects the kind of company Digital prefers to be to its employees and to the outside world on a perpetual basis, exemplified via the Digital Perpetual Clock above.

HONESTY

We want to be not only technically honest, but also to make sure that the implication of what we say and the impressions we leave are correct. When we make a commitment to customers or to employees, we are obligated to see that it happens.

PROFIT

We are a public corporation. Stockholders invest in our corporation for profit. Success is measured by profit. With success comes the opportunity to grow, the ability to hire good people, and the satisfaction that comes with meeting your goals. We feel that profit is in no way inconsistent with social goals.

QUALITY

Growth is not our primary goal. Our goal is to be a quality organization and do a quality job which means that we will be proud of our product and our work for years to come. As we achieve quality, we achieve growth.

RESPONSIBILITY

Plans are proposed by managers or teams. These plans may be rejected until they fit corporate goals or until the Operations Committee is confident of the plans. But when they are accepted, they are the responsibility of those who proposed them. The impetus for the plan may come from outside the group making the proposal, but once accepted, the proposal is the responsibility of the one who proposed it.

LINE MANAGEMENT

We particularly want to be sure that line management jobs are clear and well defined. Because so many people are dependent on the plans of line managers, it is very important that the plans have regular automatic measurements built into them. Meeting financial results is only one measure of a plan; other measures are satisfied customers, development of people, meeting long range needs of the Corporation, development of new products, and opening new markets. We believe that our commitment to planning ensures our freedom to act.

SOCIETY

We are committed as a corporation to take affirmative action in providing equal opportunity for employment and promotion for all persons regardless of race, color, creed, or sex. We encourage all employees to take responsibility in community, social, and government activities. We are always open for proposals as to what the corporation or an individual on corporation time may want to do in these areas. However, activities done on company time or with company funds should have a formal proposal including ways of regularly measuring success toward goals.

ENVIRONMENT

As good citizens we have a responsibility to keep our environment free of pollution and to set an example.

CUSTOMERS

We must be honest and straightforward with our customers. Not only must they be told the facts, but we must be sure they understand the facts.

To the best of our ability, we want to be sure that the products we sell answer the needs of the customer even when that customer is too naive to understand these needs exactly. When we sell a product to a customer, we want to be sure the corporation fulfills the obligations we took on with the sale. We sell our corporation, not a single individual, to our customers and we must be sure all Digital commitments are met.

COMPETITORS

We never criticize the competition publicly. We sell by presenting the positive features of our own products. We want to be respectful of all competition, and collect and analyze all public information about competitors. When we hire people from competitors, we should neither press them for confidential, competitive information, nor should we use confidential literature they may have taken with them.

SIMPLICITY AND CLARITY

We want all aspects of Digital to be clear and simple and we want simple products, proposals, organization, literature that is easy to read and understand, and advertisements that have a simple, obvious message. We have thousands of employees and many thousands of customers. We have to keep things simple to be sure that we all work together. Our decisions must always consider the impact on the people who will be affected by them.

ORIGINAL EQUIPMENT MANUFACTURERS

Standard products are the base of our business. At times, in certain areas, we will invest in software and hardware specifically for special markets. But we should never lose sight that the base of our business is our standard products. We are very dependent on selling to OEMs. There are more applications for our products than we could ever develop. In addition, there are many risks to be taken in developing new fields which we cannot afford. Therefore we are very dependent on OEMs, and when they take the risks and they are clever enough to be successful, we should be most respectful of their risks. When our OEMs are in trouble with a customer, we should tell them.

PERSONNEL DEVELOPMENT

We encourage people to develop technical skills, breadth of knowledge, and expertise in a specific area. We also encourage people to develop supervisory and management skills. We believe that individual discipline should be self-generated.

PROMOTION

We promote people according to their performance, not only their technical ability but also their ability to get the job done and to take the responsibility that goes with the job. Ability is measured not only by past results, but also by attitude and desire to succeed. Performance results are also used to decide if a person should remain in his or her current job.

HIRING FROM CUSTOMERS

We should be exceedingly careful when hiring employees from customers. Sometimes this is reasonable and desirable; but we should do it with all caution and by being sure that the employee first tells the customer and allows the customer the chance to compete against us.

FIRST RULE

When dealing with a customer, a vendor, or an employee, do what is "right" in each situation.

5.0 DIGITAL STRUCTURE

Digital operates on a matrix structure which is not used by many companies. Therefore, most people are not familiar with how it works. Briefly, a matrix organization is one in which many members are responsible to more than one person. It enables people from all areas of the corporation to communicate, work together, and see one another's viewpoints. This way, people feel responsible for more than one primary aspect of the business.

Figure 1-2, Digital Matrix Structure, three-dimensionally shows the interrelationships of the major corporate departments, the product lines, and field organizations.

A matrix organization is designed to provide checks and balances in decision-making as well as to ensure that major proposals receive full exploration from all interested parties. The matrix organization is one of Digital's greatest strengths, making it possible to view the overall business from a variety of perspectives. For example, it is possible to look at a single product across product lines from an Engineering or Manufacturing perspective. Sales may be viewed worldwide by product line. A single country, region, or district may be examined across functions and product lines. Product lines can develop and market products using the resources of Engineering, Manufacturing, and Customer Services organizations.

Figure 1-3, Digital Structure from an Engineering Perspective, generally illustrates the major corporate departments and major avenues of activity among them.

5.1 *Engineering* is the backbone and lifeblood of Digital, continually providing innovative products with greater capabilities. Engineering performs product development according to the plans agreed upon with product line Marketing. Engineering also performs advanced development and research, providing a high degree of technical specialization in Printer, Computer Systems, Software Engineering, and major corporate processes to maintain Digital as a major competitor in the marketplace. Engineering Services, Documentation Control, and Purchase Specifications are provided in support of Engineering.

5.2 *Product Lines* have most of the functions you would expect to find in a small company. Digital's three major product line groups are Commercial Products, Technical Products and Computer Products. The focal point for profit and loss measurement at Digital are the product

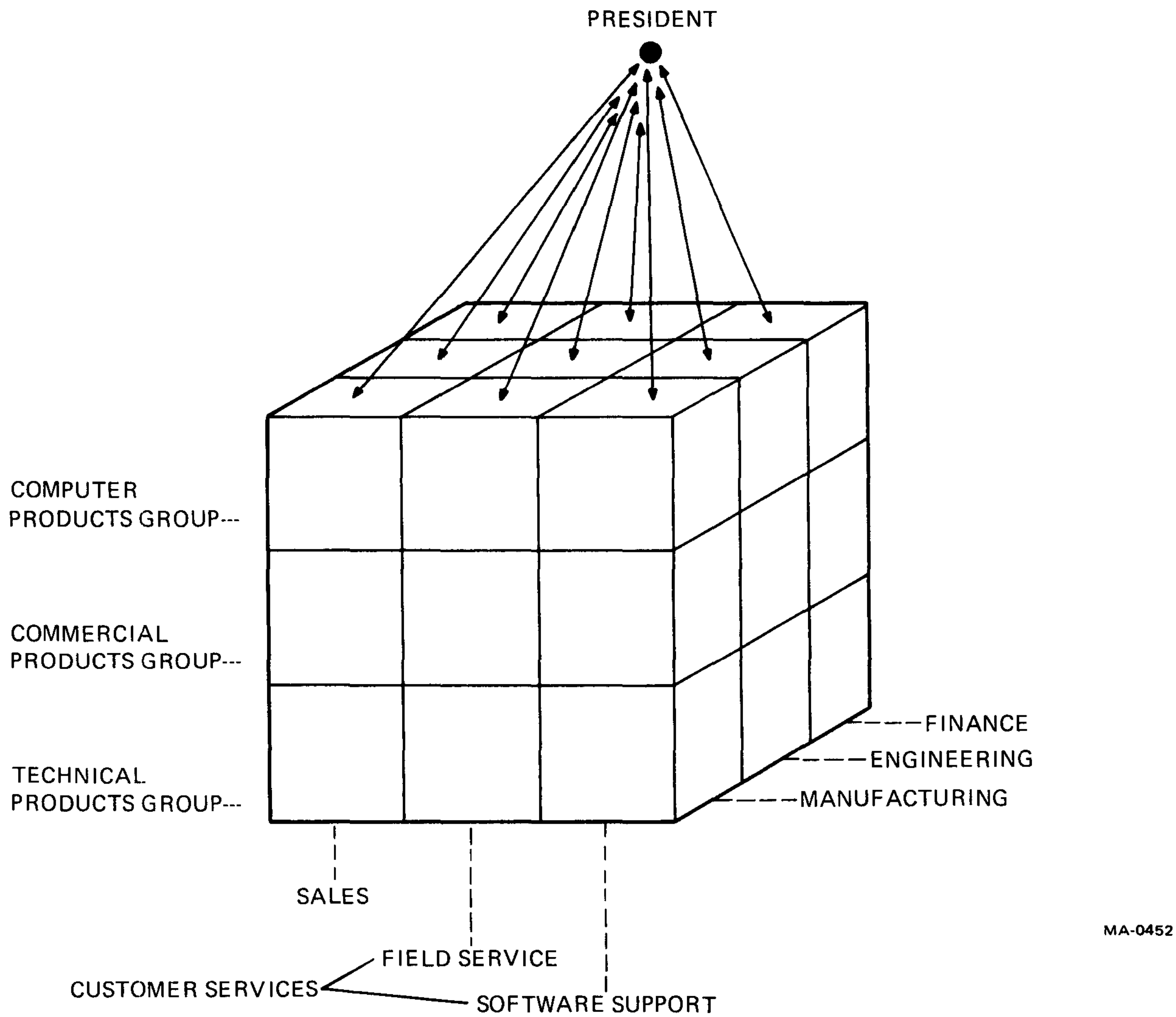

Figure 1-2 Digital Matrix Structure

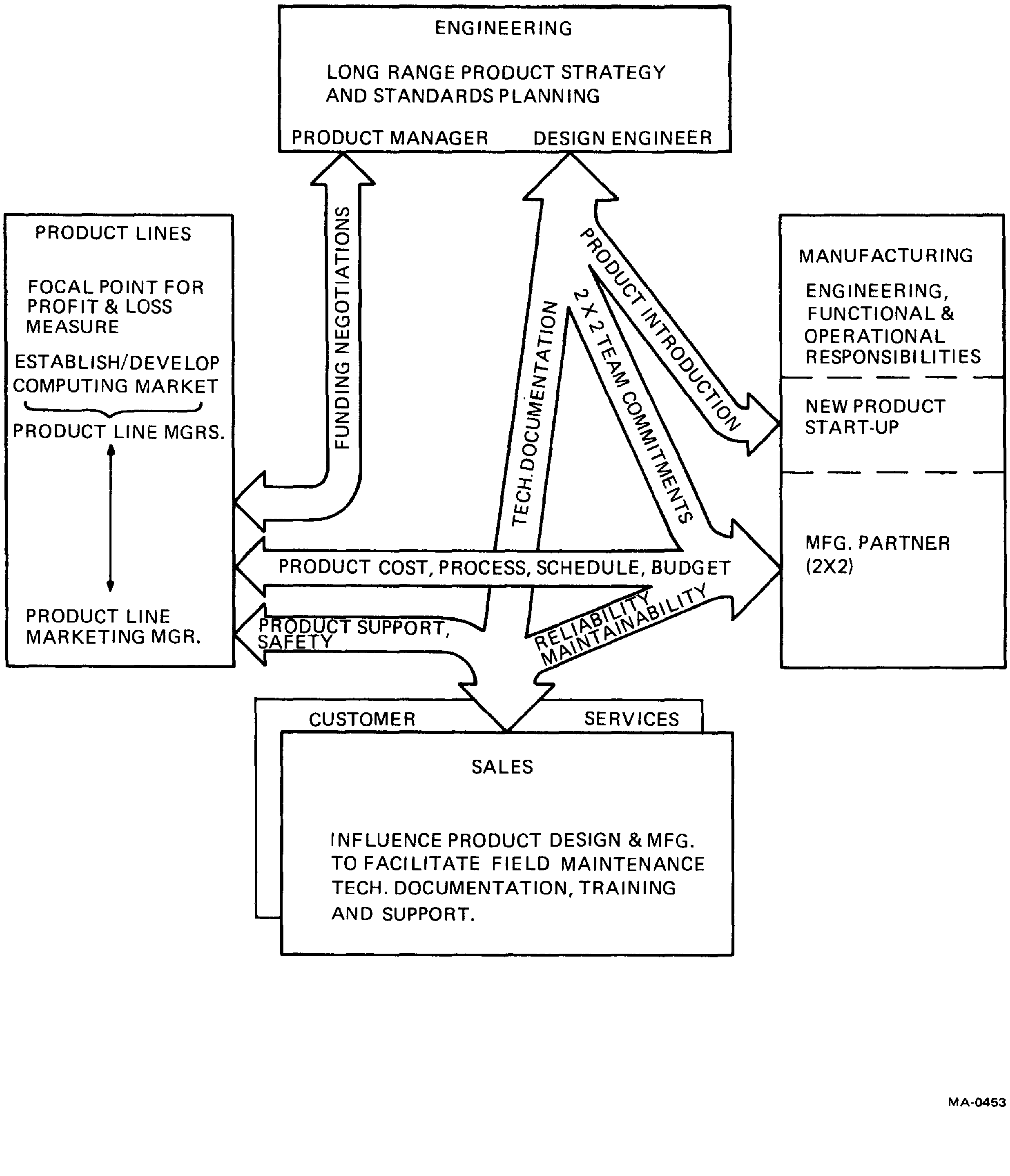

Figure 1-3 Digital Structure from an Engineering Perspective

lines. Product line managers are responsible for profits accrued by their market areas. One or more product lines within a market segment may be targeted at very specific markets with resident Engineering groups established to meet the needs dictated by product line market areas.

5.3 *Manufacturing's* function is to produce Digital's products at the product's specified quality level, at a manufacturing cost which maintains a competitive position in the market, and to a schedule that meets commitments that have been made to our customers. Manufacturing operations include approximately 26 facilities. United States locations are in New England, the Southwest, and the West Coast. International locations are in Puerto Rico, Canada, the British Isles, Germany, Hong Kong, and Taiwan.

Manufacturing has a matrix management structure composed of seven line organizations, Systems Manufacturing, Mass Storage Manufacturing, Terminals Manufacturing, CPU Manufacturing, Process Manufacturing, Component and Memory Manufacturing, and Far East Operations. Plant reporting is within these groups. The functional organizations cross all line organization boundaries. The key functions which reflect Manufacturing's activities are Manufacturing/Engineering, Quality Assurance, Materials, Distribution, Planning, Finance, Employee Relations, and External Manufacturing.

5.4 *Sales* have field offices in the United States, Canada, Europe, and General International Area locations to provide promotional and sales services. In order to serve the needs of the marketplace more efficiently, Digital's sales force is specialized; sales persons are trained to serve one or more specific market segments. For instance, there are sales representatives dealing with commercial markets, industrial markets, and educational institutions. Sales training is made available to the entire sales force.

5.5 *Customer Services* comprises many functions, three of which are Customer Service Systems Engineering, Software Services, and Educational Services. Customer Service Systems Engineering groups develop Field Service maintenance and business plans, hardware documents, training requirements, product safety requirements, reliability and maintainability programs, and evaluation of these functions during new product development. Software Services provides services to satisfy Digital's software needs in the field in the areas of warranty support, sales support, and consulting services. Educational Services provides curriculum training to anyone, customer or employee, interested in Digital hardware, software, or a variety of other computer-related topics. This group also designs and teaches custom-tailored courses to meet the special needs of a customer. They have extensive facilities in Massachusetts and in major cities around the world.

SECTION 2

FUNDING FOR PLANNED AND UNPLANNED PROJECTS

1.0 PLANNED PROJECTS

The preparation of Engineering budgets is actually a year-round activity. Engineering is continually involved in the refinement of product development tactics and the evaluation of product development issues and opportunities which arise during the year. These activities dictate a need for flexible budget modifications.

For the purposes of budgeting, Engineering divides its total allocation into two clusters: POTS and NON-POTS. POTS are product-related development activities, and NON-POTS are non-product-related development activities.

POTS Activities

- Commercial Systems
- Real Time and Computation
- Nets and Communication
- Small Systems and Terminals
- Base Systems
- Storage Systems
- Large Systems

NON-POTS Activities

- Product Support
- Development Tools and Technologies
- Research and Advanced Development (RAD)
- Administration
- Product Management

The term "POT" is used to describe each of six product/market segments outlined above. The term was originally coined as a "POT" of product development money. Each POT represents a grouping of products based on the level of product integration and, in some cases, the degree to which a product is driven by technology versus marketplace requirements.

The primary goal of POTS is to couple market requirements with product strategies. Thus, formal management of each POT consists of a chairperson from a product line and a strategy manager from engineering. The remaining membership on each POT consists of 8 to 12 engineering managers appointed by the Engineering Board of Directors (EBOD).

The budget allocation process for product development (POTS) and non-product development (NON-POTS) is described in the steps that follow:

Step 1
The Office of Development (OOD) proposes a partitioning of the Engineering budget between POTS and NON-POTS. This proposal is then reviewed by EBOD. The allocations are driven heavily by historical considerations but they permit an adjustment of emphasis between short-term and long-term growth investments. The result of this step is a total product development budget figure and a comparable figure for non-product development.

Step 2
In a parallel effort, engineering managers and their team members from the product lines submit a "wish list" to the POT (that involves their strategies and product families) for consideration by the POT. The "wish list" includes both current product development efforts and proposed projects that are within the realm of current strategy.

Step 3
Each POT reviews its "wish lists" submitted to them and evaluates them against current strategy. Each POT then discusses alternative product development strategies and their implications to product line plans and marketing strategies. Additionally, each POT assesses the impact of not pursuing certain products. Finally, the engineering group develops a consolidated POT strategy and recommended budget for proposal to EBOD.

Step 4
EBOD reviews all of the POT funding requests and determines what the initial allocation will be for each POT. This allocation reflects the degree of emphasis EBOD believes ought to be given to the development efforts of each product/market category, considering the strategies of each. EBOD then sends its recommendations back to each POT, and steps 3 and 4 are repeated.

Step 5
At this step, EBOD can finalize the budget allocations, adjust the allocations among POTS, or it can go back to the Operations Committee and request a budget increase. At the same time, EBOD finalizes the budget for the forthcoming year, it establishes projected budgets for the two succeeding years.

Step 6
EBOD presents the final POTS budgets to the Marketing Committee for ratification. In addition, the Office of Development presents its final NON-POTS budgets to the Marketing Committee for ratification.

2.0 UNPLANNED PROJECTS

There are four sources to which engineers may turn for funding of unplanned projects. Unplanned projects may be funded by the Office of Development's contingency funds, by product line, by receiving cross-funding from another engineering group, and by the Research and Advanced Development (RAD) Committee.

Office of Development (OOD) Contingency Funds

Although POTS attempts to anticipate their yearly development efforts, they must also anticipate the actions of competitors, stay abreast of technological advancements, and adjust their developmental activities accordingly during the year. For these reasons, the Office of Development has a contingency fund (approximately 5% of the total budget) to finance a limited amount of unanticipated efforts without exceeding the established Engineering budget. A project manager or development manager has access to these funds.

Product Line Funding

If the project which the development or project manager proposes to undertake has application to a single product line, he or she can request direct funding by the product line. Each product line sets aside a certain percent of its net-operating revenue to be used for product line engineering. The engineering group within the product line can finance a proposed project, or Engineering can directly fund the project for the product line. A project manager or development manager has access to these funds.

Cross-Funding

In those cases where a engineering manager is supplying services, he or she may receive cross-funding from another engineering manager. A typical example would be the services of the packaging group being used by a CPU development group.

Research and Advanced Development Funding

Occasionally, projects evolve from such alternative avenues as informal discussions, reviewing the current technical literature, and changing market demands. An engineer's personal interest in a particular idea may result in a "lunch room" project, one which may ultimately benefit the company. To encourage and support such projects, Engineering allocates 1% of its research and advanced development budget each fiscal year for the research and development of unplanned projects. The total research and advanced development fund is 13% to 15% of the Central Engineering fund.

If you have a product which you believe will make a significant contribution to the future of Digital, submit your project to the Research and Advanced Development (RAD) Committee in the form of a preliminary project proposal. RAD will consider potential projects and permit you to sidestep regular management approval.

Your proposal should be submitted to a RAD Committee member or the technical coordinator of the RAD Committee, Dan Goor (ML12-2/E71 223-2895). It should briefly describe the nature of your effort, the resources required, the anticipated technical payoff, and the project's relationship to the organizational strategy.

The Research and Advanced Development Committee will review your proposal to determine if money should be spent to test the technical soundness of your project. RAD will then hold a follow-up review by qualified engineers. RAD may also allocate funds to articulate your project to other levels within Digital (e.g., Marketing, Manufacturing).

Because RAD receives more project ideas than it can afford to finance, money is allocated only to those projects which demonstrate promise. Roughly half of all project proposals receive funding for further research.

SECTION 3

LIFE OF A HARDWARE PROJECT

1.0 SCOPE

From product inception to steady-state production, a project involves considerable planning that addresses:

a. What to build

b. How to build it

c. Who is involved

This section addresses the three questions above by presenting an overview of the life of a hardware project. This information is intended to help you, the new engineer, (1) determine what your responsibilities are, (2) understand how you are involved, (3) know which groups you will interact with, and (4) know when to contact those groups during the process.

2.0 RESPONSIBILITIES

Your job is to find out what is right, and then do it. Digital's products are used in critical applications where malfunctions can be expensive for our customers, and in some cases, cause injury to people and property. You are the only one who understands your product completely, so decisions which affect these kinds of applications must be sound decisions.

It is not always sufficient to do what is right. You must convince others of what is right. This is in part a check on your ideas. One of the most difficult adjustments you may have at Digital is realizing that you have little authority over many aspects of your product, even though you are responsible for all of it. Therefore, good communication is essential for others to understand your ideas. You may begin by talking with your associates, putting it in writing, and picking up the phone. You should begin to wonder about your decisions when you can't convince others of the soundness of your ideas. Trying to persuade others of what you think is right also forces clarity in your thinking.

Because good communication is a very important part of what is right, you must understand how your specifications will be interpreted. You must be sure Field Service, Sales, and customers understand the limits and potential of a product's specifications. Malfunction from misuse by a customer is an acceptable excuse only if the customer has ignored clear and accurate information that what he or she is doing constitutes misuse.

If you bring honesty, integrity, and love to the people with whom you work, you are bound to succeed. Others who look upon Digital's method of product development as a silly game are bound to fail. It's up to you.

3.0 INTRODUCTION

Effective development and support of our products is essential. Remember that a product is more than hardware; it is software, documentation, Marketing, Manufacturing, and Field Service support. It is reliability and it is profitability.

The individual designated as product manager for a product has the overall responsibility for a product, and direct responsibility for pricing and marketing. The identity of a product manager may be found in the Option Module List published by the Office of the Chief Engineer (Section 5, paragraph 3.7). If a manager is not listed there for your product, then you, the design engineer, must assume that responsibility.

As a design engineer, or as a contributing engineer to a project, you must give your attention to the product manager and the product line(s) support and development people to coordinate activities in other areas. Be sure that the product manager does not overcommit you, yet keep in mind that you owe him or her the best product that money can buy. You owe your complete cooperation and self-respect to all of the people who work on your project.

The development stages of a hardware project are illustrated in Figure 3-1. Shown there are the milestones in the life of a hardware project. Sheet 1 outlines the processes that involve you and your 2x2 partner* directly. Sheets 2 and 3 show procedures carried out by Manufacturing, Field Service, Marketing and Sales, and Diagnostic and Reliability Engineering in parallel with you and your 2x2 partner. The paragraphs which follow explain Figure 3-1 in detail.

Refer to DEC Standard 130, Guide for Product Business Plans, for the complete product planning methodology used by Digital to initiate new product development. The standard describes the product planning process, the phases of product development, and the phase review process. (Contact Standards and Methods Information and Control, ML5-2/E56, 223-2954, for a complete listing and copies of DEC Standards.)

References to "Software Engineering" in this section are monitor or operating system groups which provide the software necessary for your hardware product to work. For an overview of the life of a software project, see Section 4.

* Your Manufacturing 2x2 partner is identified by your Engineering Manager, Manufacturing Group New Product Manager, or Joe St. Amour, manager of the Manufacturing New Product Start-Up Group.

3.1 PLANNING (WHAT TO BUILD)

Many people must work on a project besides those for whom and to whom you are responsible. Starting a project involves careful planning and requires much interaction and effective communication both vertically and horizontally at all levels of the corporation to insure that the many elements of a project work together in synchronization toward a common goal.

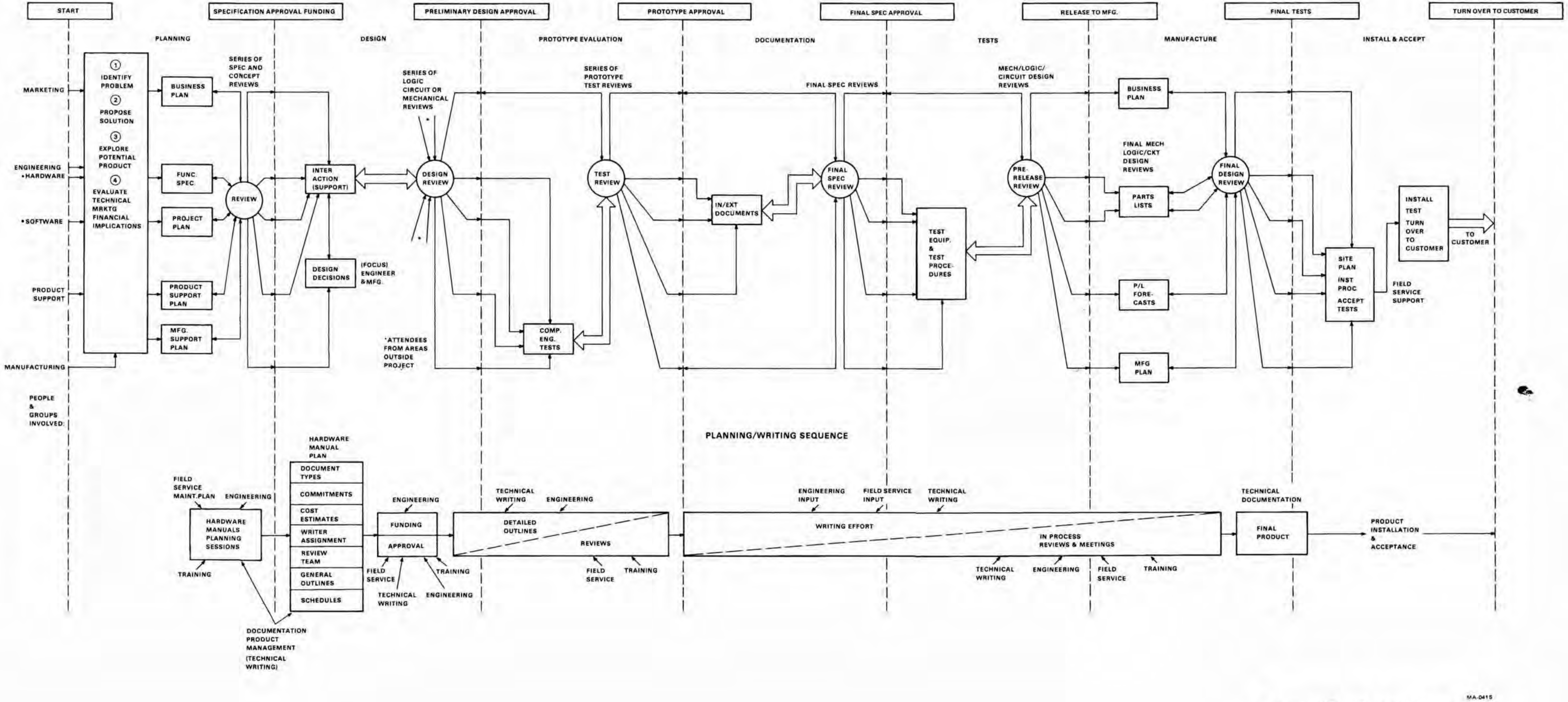

Figure 3-1(A) Life of a Hardware Project

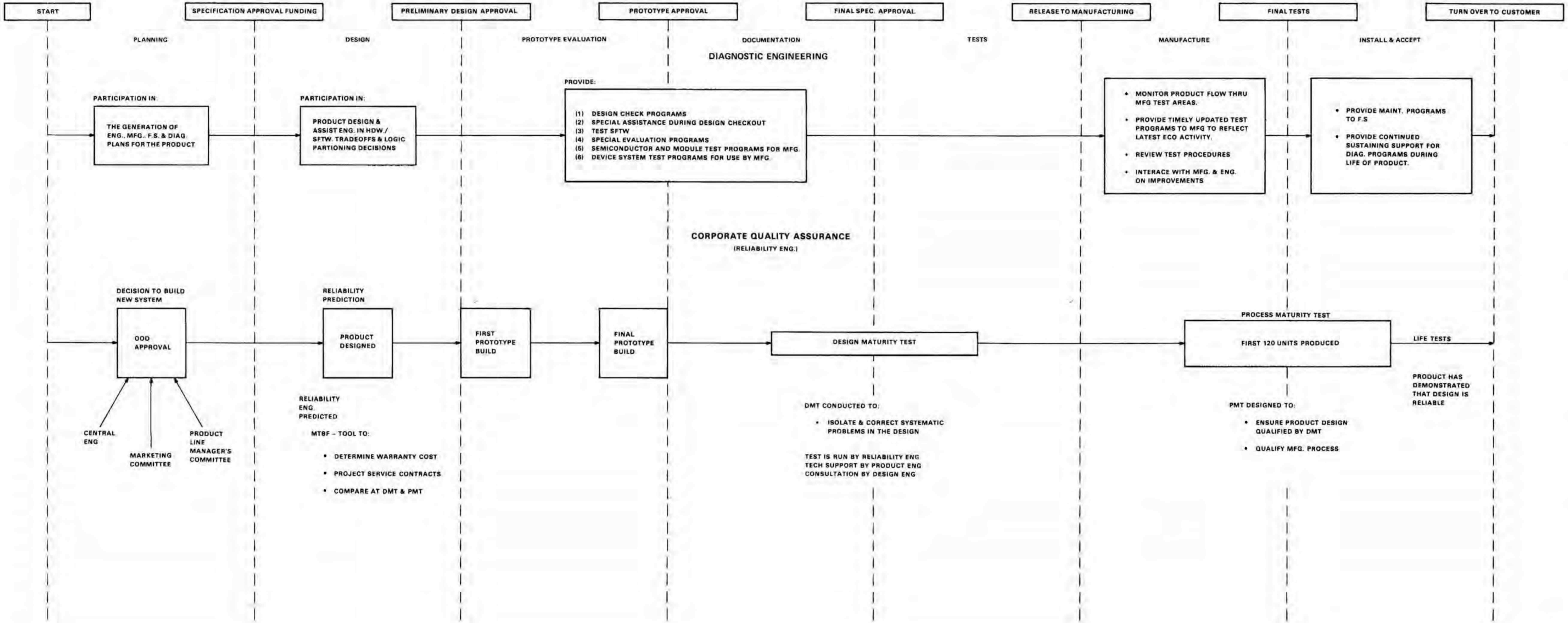

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Figure 3-1(B)   Life of a Hardware Project

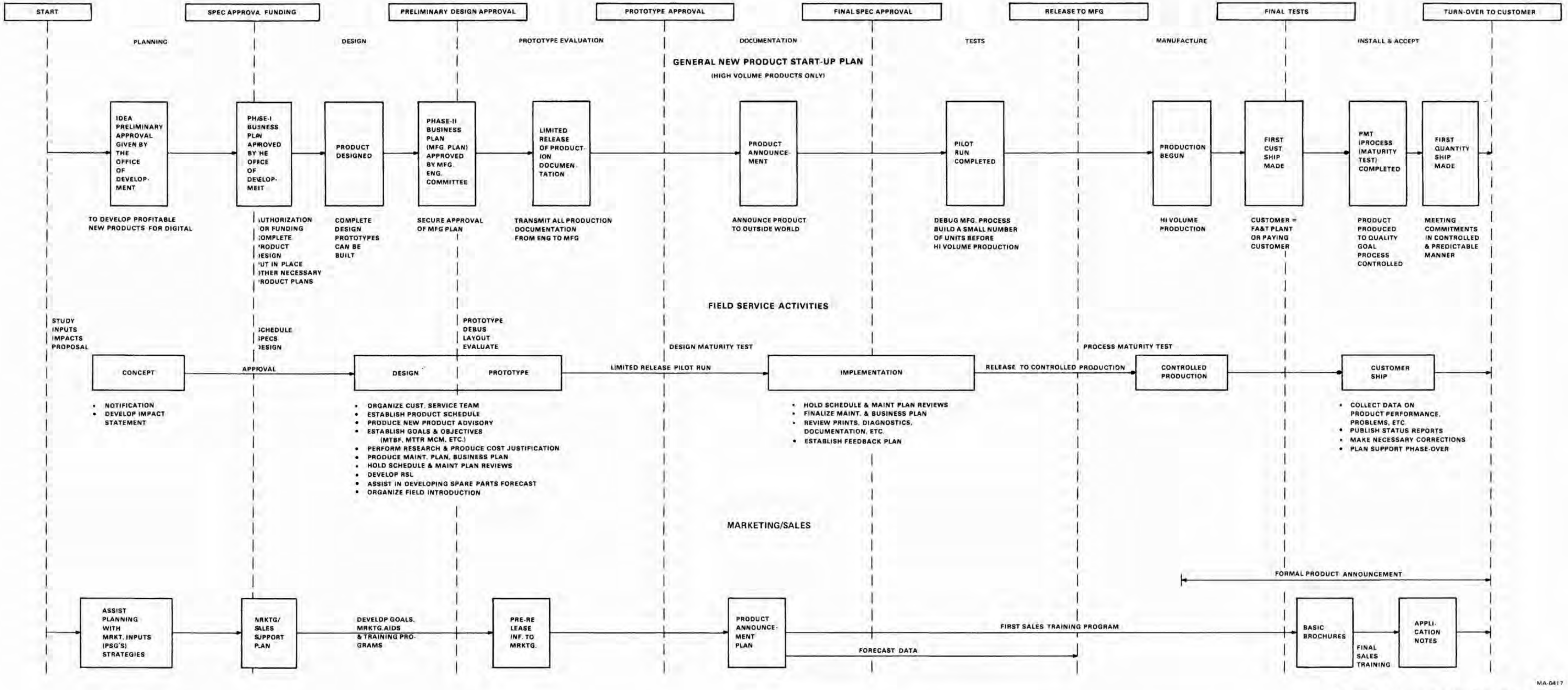

Figure 3-1(C) Life of a Hardware Project

The following paragraphs identify the objectives, the people and groups involved, and the tools necessary to ensure that Digital's products are both reliable to the customer and profitable to the corporation.

Objectives

- To identify a problem, a set of problems, or simply the needs of our customers, and propose a solution that will satisfy the customers and bring profit to the corporation.
- To explore and define a solution (a potential product) by evaluating its technical, financial, and marketing implications.
- To provide enough clear information to allow the people with the funds, or the appropriate POT Committee, to approve further planning. Delays in funding do not curtail development; planning continues unless all interested people are notified to stop.

People and Groups Involved

- Project Engineer
- Product Manager

> May be the same person

- Product Line Manager(s)
- Product Line Marketing
- Software Engineering
- Customers
- Manufacturing

Tools

- Engineering Proposal (essentially, this is a project specification, refer to DEC Standard 009)
- Project Plan (scheduling – refer to DEC Standard 008)
- Product Business Plan (refer to DEC Standard 130)
- Manufacturing Support Plan (refer to "Manufacturing New Product Start Up" in Section 7, paragraph 1.0).
- Specification and Concept Design Review Process (refer to DEC Standard 007)

A project's plan typically covers three to five years once the project enters the design phase. For products already in support of equipment, project plans cover about five years. Major decisions on new products are usually made during the formulation of project plans.

It is often difficult to determine when the "What to Build" phase ends, but project approval in the forms of official funding and a Design Review of the functional specification are two indications that usually mark the end.

Do not assume that the "What to Build" phase is complete when the functional specification is written. Keep in mind that it may be 1) incomplete, 2) inconsistent, or 3) impossible for reasons you discover during the design phase. In such cases, the specification requires updating with the concurrence of at least the product manager and the product line marketing managers where major products are concerned, and the concurrence of at least two people (remember that the project engineer and the product manager may be the same person).

NOTE

The specific aspects of the Design Review process such as when they should be performed, what they should attempt to do, etc., vary according to your project, and as a result may not require all the reviews presented in this section. Refer to DEC Standard 007 for answers to the following questions:

- Which projects require Design Reviews?
- How is a Design Review Committee formed?
- When are Design Review sessions held?
- What are the responsibilities of the Design Review Committee?

The purpose of holding Design Reviews is to aid you in developing your project by allowing you to use available technical expertise from other areas in the corporation. Design Review Committee members are sounding boards for your ideas and concepts. Design Reviews also permit Product Safety and other concerned groups to ensure that your project meets applicable regulations and standards.

Before entering the Design phase, a *Specification and Concept Review* should be held to ensure that the specification:

a. Completely describes the equipment to be designed, including electrical and physical interfaces, and a functional relationship between inputs and outputs.

b. Outlines how the implementation of the design is planned, providing details such as block diagrams, flow diagrams, analysis, specifications for sub units, etc.

c. Includes proposed mechanical, thermal, and power requirements; requirements and concepts for packaging, testing, and maintenance.

The planning of a project does not happen overnight and sometimes seems to take an excessive amount of time. The purpose of spending time is to allow the business and support managers to implement the requirements of your project in their plans with the confidence that they are working on the same project as you. Give them time so that they may meet the scheduling commitments necessary for a successful product.

3.2 DESIGN: (HOW TO BUILD IT)

A 2x2 method of product development is used at Digital. Every product oriented project is managed by a two-person team, one from Engineering and one from Manufacturing. They make design decisions, decisions on how the product will be built, and both are jointly responsible for introducing the product into Manufacturing.

Engineering responsibilities include:

- Planning, Design, Testing, Documentation
- Coordinating Start Up (jointly with Manufacturing partner)
- Support of Production and Field Service
- Meeting cost goals
- Shipping on schedule

Manufacturing responsibilities include:

- Preparing and implementing Product Introduction Plan
- Influencing design to ensure manufacturability
- Capacity forecasting
- Ensuring volume production-documentation and successful implementation
- Prototyping

It is highly important for you to identify your 2x2 partner as soon as possible. Refer to "Manufacturing New Product", Section 7, paragraph 1.0, for direction to the right people to contact.

Objectives

- Design a product that the customer can use
- Design a product that is as compatible as possible with existing software systems
- Translate the functional requirements into a design that Manufacturing can build
- Provide a design that is serviceable by Field Service representatives
- Provide enough detail to allow support groups (Drafting, Educational Services Development and Publishing, Test Personnel, Programmers) to do their jobs

People and Groups Involved

The engineer and Manufacturing 2x2 partner do not do it all themselves. They require the assistance and services of many support groups to accomplish their task. The people within the groups listed below have developed special expertise in their own areas. The assistance they offer is presented in detail in other sections of this manual.

- Design Engineer

- Manufacturing 2x2 partner

- Software Engineering
  Defines software user documentation; helps to define schedules to relate to major operating system releases; helps to define software interface; creates drivers and defines intelligent tests and standards; helps define engineering specifications for compatibility, migration, and new functionality

- Component Engineering
  Helps research and specify component needs

- Purchasing
  Helps with vendor selection, sourcing, and problem solving

- Engineering Services
  Provides manual and automatic design drafting assistance, watches drafting spending and acts as a communication link for all Engineering Services

- Standards and Methods Information and Control
  Provides copies of DEC Standards

- Technical Systems and Services
  Provides resources for optimizing the manufacturability of printed wiring boards, modules, and backplanes

- Diagnostic Engineering
  Assists in hardware/software tradeoffs and logic partitioning decisions; generates diagnostics for your product

- Model Shop
  Supplies fabrication in metal, wood, plastic, clay, and foam; assembles prototype modules, small assemblies, and cable harnesses; provides PC board modules, hand testers, low volume blasting of PROMs and ROMs

- Educational Services Development and Publishing
  Provides technical documentation planning, technical writing services, publication services, printing and distribution services

- Mechanical Engineering
  Designs packaging, evaluates materials, measures heat transfer and flow, tests connectors; designs castings and molded parts

- Industrial Engineering
  Performs industrial design, formulates appearance and product design concepts (panels, colors, etc.)

- Customer Service Systems Engineering
  Helps design support features and plans for field support (the Support Plan introduces the product to all Field Service offices)

- Reliability Engineering
  Provides early Mean Time Between Failure (MTBF) predictions

- Appropriate Process Engineering Group
  Consult your 2x2 partner about Digital's way of manufacturing and testing a new product; if necessary, Manufacturing can design fixtures and tools to facilitate the manufacture and testing of a new product

- Manufacturing Test Applications
  Assists in Hardware/Software decisions to generate diagnostics for Manufacturing applications

Even though you may not need the services of all the groups listed above, you should know how they can help and at what stage of product development you should seek their help. You may find all of these services in the index of this manual.

Tools

- Module Manufacturing Standard with PDQ Questionnaire (refer to DEC Standard 30)
- Functional Specification (refer to DEC Standard 009)
- Engineering Project Plan (refer to DEC Standard 009)
- Field Maintenance Plan (refer to DEC Standard 117)
- Manufacturing Plan (refer to Manufacturing 2x2 partner)
- Other applicable DEC Standards

A logic circuit, and mechanical design review should be held prior to ending this phase. People from outside the project attend these reviews, offer their advice and help you find problems.

A *preliminary logic design review* should be held as soon as possible after completion of the design and prior to generation of board(s) layout. The data should include the logic diagrams, some form of specification, timing diagrams of critical paths, etc.

A *preliminary circuit design review* (not applicable to pure logic using chips) should be held as soon as the circuit is designed and the supporting analysis and critical portions have been breadboarded, and prior to the generation of artwork and detailed packaging. The data available should include the schematic, parts lists, stress calculation, stability analysis, power requirements, MTBF (Mean Time Between Failure) estimates, and supporting test data.

A *preliminary mechanical design review* should be held prior to generating a complete set of drawings so that inputs from Manufacturing, Field Service, and other attendees may be considered. You should show sufficient detail in the project specification, or on a separate mechanical specification, to ensure that the design will meet all requirements. You may include sketches, models, mock ups, and/or assembly drawings, analysis, and calculations to show thermal and structural integrity.

3.3 PROTOTYPE EVALUATION

Objectives

- To build a prototype and test it
- To shake the bugs out of your design
- To determine preliminary compatibility of software operating system support

People and Groups Involved

- Engineering
- Software Engineering
- Component Engineering
- Model Shop
- Diagnostics
- Environmental Engineering
- Reliability Engineering
- Manufacturing Test Applications

Tools

- DEC Standard 181 (Backplane Development Process)
- DEC Standard 030 (Printed Circuit Manufacturing Specifications)
- DEC Standard 142 (Prototype Development Process details)
- DEC Standard 102 (Environmental Standard for Computers and Peripherals)

To build a prototype, you will probably need the services of the Model Shop. They have the facilities to assemble prototype modules, small subassemblies, wire-wrap, cables, harnesses, etc. The Model Shop is described in Section 5, paragraph 3.4.3.

Digital has environmental test chambers that test for heat, humidity, supply voltage, frequency, and other factors that affect product safety. These factors may be isolated or coupled. Outside test facilities are used for additional testing as required by the constraints of a project.

Your test strategy during the prototype phase depends on the intended market, the intended manufacturing process, and the product itself. Component Engineering, the responsible Process Engineering group (CPU, Disk/Tapes, Terminals, Cross Products), and the Reliability Engineering can help with test strategy. The Reliability Engineering can also help in statistical analysis. You will also need Diagnostics to help test your products. Ensure that Diagnostic Engineering's schedule meshes with your own.

When you are satisfied with your design, Reliability Engineering will evaluate engineering prototypes and/or initial manufacturing pilot units. Environmental Engineering and Acton Labs will do the testing required by DEC Standard 102. Refer to this standard for more information.

A *prototype test review* is held to examine the results of prototype testing and to draw conclusions from the test data. This information should be presented to the reviewers and corrective action should be discussed in detail.

NOTE

This review is held only if the prototype evaluation has changed the specification.

3.4 PRODUCT DOCUMENTATION

You must provide all the detailed information necessary to allow in-house people to develop all the documentation required to build, sell, support, and maintain your product.

Objectives

- To describe clearly, accurately, and completely the product you plan to build
- To ensure that adequate documentation is made available to all users and maintainers

People and Groups Involved

- Creators of Documentation
  - Design Engineers and Technicians
  - Engineering Services
  - PC Layout (manual and automatic)
  - Manufacturing, Maintenance, and Engineering (Reference) Documentation

Design Engineers and Technicians
Training (Educational Services)
Field Service Marketing
Educational Services Development and Publishing — User and Service Documentation
Software Documentation
Advertising

- Users of Documentation
  - Manufacturing
  - Field Service
  - Training
  - Customers
  - Software Engineering
  - Field Service Depot Repair

- Maintainers of Documentation
  - Engineering Services (ECOs) - Manufacturing, Maintenance, and Engineering (Reference) Documentation
  - Educational Services, Software Documentation — User and Service Documentation

Tools

- Functional Specification
- Field Service Philosophy
- Applicable DEC Standards
- Parts List (DEC Standard 025)
- Complete Parts List, including part descriptions for all assembly levels of the product
  - Parts List - Engineering Responsibility
  - Part Descriptions

Documentation is required to allow Manufacturing to make your product, Field Service to service it, and ECO (Engineering Change Order) Control to implement document changes when specification changes are made. User documentation allows our customers to buy the appropriate products and get the best use from our products.

You should contact Educational Services Development and Publishing, Software Documentation, Advertising, and your Engineering Services satellite supervisor when you are setting up your schedule. They can help you with your schedule and your budget for documentation.

In general, the more information you put into your specifications, drawings, and product descriptions, the faster and better the documentation job. The biggest problem in the technical documentation area is access to good information. Try to make yourself available to answer questions. Shortcuts, skimpy information, and sloppy drawings greatly degrade the documentation. All documentation must meet the requirements of DEC Standard 182 (Engineering Documentation Acceptance Criteria).

Clear and precise documentation allows our Field Service people to save money. Most important, it makes them more efficient. This is especially important since the supply of qualified people is limited. You will obtain a significant cost of ownership savings for your product's customers by making sure you get the best documentation possible.

PC layout may be manual or automated. The manual job takes an average of 10 to 13 weeks. The automated job takes less time. For hex boards made to DEC Standard 030 with fewer than 100 ICs, automated PC layout takes an average of 6 to 8 weeks.

A *final specification design review* is held to ensure that the specification is correct, complete and acceptable. The data supplied to the reviewers is a complete specification including drawings.

Once you sign-off your product documentation, your drawings go under ECO (Engineering Change Order) Control, and you must sign off any changes made after that. DEC Standard 100 describes the requirements for an Engineering Change Order.

Make sure that the Training Department (Educational Services) is aware of your product and is scheduled to give courses at the appropriate time. They can give you feedback on how much documentation is necessary. If you do not supply the Training Department with the information they need, they will have to write the training materials themselves at a greater expense and with less general usefulness. It will cost them more because often they have less information with which to work. And their final product will not be as useful because training materials do not receive the same kind of distribution that standard user manuals receive.

3.5 REQUIREMENTS FOR TESTING

Equipment for testing, procedures for manufacturing, and field fault analysis procedures must be made available for testing prototypes and first-manufacturing builds.

Objectives

- To ensure that proper manufacturing testing equipment and procedures are available
- To ensure that proper testing equipment and procedures are available for installation and service
- To balance the cost of manufacturing and servicing the product with the cost of testers and test programs over the life of the product

People and Groups Involved

- Engineering
- Manufacturing 2x2 partner
- Test Strategist
    A representative from the responsible Process Engineering group (CPU, Disk/Tapes, Terminals, Cross Products).
- Customer Service Systems Engineering
- Technical Systems and Services
- Environmental Engineering
- Software Engineering
- Diagnostic Engineering
- Manufacturing Test Applications
- Reliability Engineering

Tools

- Test Strategy
- Business Plan (for projected volume, see DEC Standard 130)
- Manufacturing Plan

The people involved at this stage of your project should combine their technical know how in developing the Manufacturing and Field Service Strategies.

The responsible Process Engineering group will take care of the test requirements for volume production. Testers and module fixtures are handled through Test Equipment Manufacturing (Process Engineering group in Acton).

Pre-release mechanical, logic, and circuit design reviews are held as necessary to examine the details of changes required in prototype builds as result of something observed in testing. These are held prior to release for production. The reviews may be combined if changes are minor.

3.6 MANUFACTURING

Manufacturing will build your product in volume. To make this happen, you must first introduce your product to Manufacturing. It is imperative that the Manufacturing facility building your product, and your 2x2 team partner, be identified early in the life of your project.

Objective

- To translate your design into a product our customers can use

People and Groups Involved

- Engineer
- Software Engineering
- Manufacturing 2x2 partner
- Field Service
- Responsible Process Engineering Group
- Diagnostic Engineering
- Manufacturing Test Applications
- Technical Systems and Services
- Producibility Committee
- Design Drafting
- Marketing (Product Lines)
- Relevant Plant's Materials Manager
- Purchasing
- Component Engineering
- Purchase Specifications

Tools

- Printed Circuit Release Flow (DEC Standard 142)
- Wire Wrap Backplane/Module Release Process (DEC Standard 181)
- Product Line Forecast (Brown Book)
- Purchase Specifications (Component Engineering)
- Business Plan (DEC Standard 130)

The following items are necessary for introducing a product into Manufacturing:

- Training for Technicians (Manufacturing Training Courses)
- In-Plant Support (Diagnostic Engineering)
- Diagnostics and Tester Software
  Major systems use Automated Computer Testing (ACT)
  (Software for such systems must be budgeted separately) or Automated Product Test (APT)
- Tapes for insertion, or templates (Manufacturing Tool Generation, Acton)
- Models if required (Model Shop)
- Multi-sourcing for new components
- Incoming inspection procedures and test equipment — Component Engineering
- Testing Procedures for components

The Engineer, Customer Service Systems Engineering representative, and the Product Manager, with the assistance of the systems programmers, diagnostic programmers, and Software Services people should have combined their efforts in supplying the proper installation procedures to the Educational Services Development and Publishing group handling your documentation needs.

The Educational Services Development and Publishing group needs time to publish that information prior to the product delivery date. When the product is operating properly, after installation and testing, it is then turned over to the customer.

After the first product is built, *final mechanical, logic, and circuit design reviews* are held to examine problems and to propose corrective actions early in production.

3.7 PRODUCT ANNOUNCEMENT AND FIRST CUSTOMER SHIP CRITERIA

Before a product may be announced and subsequently shipped to the first customer, you must ensure that it has been properly designed, tested, and manufactured. You must also ensure that all the necessary support facilities are prepared, that Digital is shipping a quality product that does what it is supposed to do, and is fully supported in the field.

The following items generally constitute the minimum criteria which must be met by Engineering for hardware product announcements and first customer ship.

Announcement Criteria

1. All pilot tests using specified production test facilities are carried out. All equipment and procedure problems are corrected.

2. System Evaluation Engineering tests to verify functional specification, as well as bus compatibility. The process is complete when System Evaluation Engineering has written the final report that states the product works on a system and there are no outstanding problems.

3. Product conforms to DEC Standard 102 (Environmental Standard for Computers and Peripherals).

4. Product conforms to DEC Standard 60 (DEC Policy: National and International Testing Labs).

5. Product conforms to DEC Standard 119 (Digital Policy and Practices Relative to Product Safety).

6. Run Time and Coverage goals are demonstrated by responsible Diagnostic Engineering group.

First Customer Ship Criteria

1. All acceptance tests are completed.

2. Scheduled first customer ship diagnostics are signed-off by Field Service, Engineering, and Manufacturing.

3. Digital Diagnostic Center (DDC) diagnostics are signed off by Field Service.

For more information about Digital's Product Announcement and First Customer Ship criteria, including responsibilities for Product Management, Marketing, Manufacturing, and Field Service, contact John Shebell at 223-3101 for a copy of the Corporate Policy for Product Announcement and First Customer Ship.

3.8 VOLUME SHIPMENT

The purpose of this phase is to produce the product in a steady state high volume manufacturing environment. The product is usually optimized through one or more ECOs (Engineering Change Orders).

3.9 · PRODUCT RETIREMENT

The purpose of this phase is to develop an integrated retirement plan which will be coordinated with further new product development activities. A Phase out plan is developed by the Product Manager, with support from the Product Lines, Manufacturing, and Customer Services. The new product that is planned to replace the phase out product will cover the transition period.

SECTION 4

LIFE OF A SOFTWARE PROJECT

1.0 SCOPE

This section contains general information for new software engineers regarding computer facilities, quality methodologies, the software development process, and the Phase Review process. For the development of software products, this section addresses:

a. Who is involved

b. What documents/activities are required

c. When the documents/activities are required

This section is not intended as a substitute for the more detailed *Software Development Policies and Procedures Manual.* It is intended only as a pointer to that manual by providing an introductory overview of the software development process (Contact Gladys Pannell, ML12-3/E80, 223-6720, for a copy of the *Software Development Policies and Procedures Manual*).

2.0 GENERAL INFORMATION

Computer Facilities

Computer facilities for software engineers are located in the Maynard Mill, Merrimack, Marlboro, Reading, and Tewksbury. Each facility has a set of machines and supplies to help you do your job. If you sit down with your project leader or supervisor, he or she can tell you where paper is stored, how you may schedule machine time, how to get an account number, how to report a machine malfunction, and how to get it repaired.

Each major software development group has an operations manager who oversees the equipment and supplies for your group. In the Maynard Mill, contact Don Crowther (ML5-5/C10, 223-6531) for general information about base level machines, time sharing devices, etc. In Merrimack, contact Jim Friel (MK1-1/K09, 264-6601). In Tewksbury, contact Pauline Nist (TW/D19, 247-2123). In Marlboro, contact Steve Jablonsky (MR1-2/E69, 231-6377), and in Reading, England, contact Frank Jackson (RE/x205).

How to Develop Quality Software Products

Software Development uses certain processes and tools to ensure the quality of software products. For example, *code inspections* carried out periodically in the development of software attempt to spot problems before they become expensive problems. The more bugs found early in the development process, the easier it is to maintain the product later. In the published literature on this topic, one study has shown that an error that might cost $50 to fix in the requirements stage costs $1800 to fix in the integration and systems test stage.

One method of spotting problems early is the process of using *base levels*. Base levels are stepping stones in the development of software. The Project Leader plans and controls what goes into each base level. These are functional stages (i.e., each base level is a testable unit that can run alone) which build on one another until code is developed which has many functions. Because many people must work on code beside yourself, the practice of using base levels allows others to integrate their base level functions with yours at various stages of coding.

Tests are performed after base levels are reached to build confidence that the code does what it is supposed to do as it continues to evolve. A clear advantage in using base levels is that as each level is tested and finalized, later debugging of the complete code can be kept to a minimum.

To further ensure the highest quality in software products, Software Development uses a standard high-level language for software projects. For this purpose, *BLISS* is the preferred implementation language. BLISS implementations are normally cheaper and easier to maintain than assembly language implementations. They also offer opportunity for reasonable portability for part or all of the program under development. For more information about Software Development's policy on BLISS usage, see the *Software Development Policies and Procedures Manual*, Section 7A3-2.A.

Another method of ensuring the quality of software products is the process known as DECnet *certification*. Certification is a method of validating a product's ability to carry out its DECnet functions with all other DECnet products. The purpose of this method is to establish a single set of standards to maintain general interconnectability among DECnet products. It is also used to ensure the compatibility of products at the user level. As Digital grows, certification will be used for most software products.

Ensuring quality software products also includes meeting the *minimum ship criteria*. The minimum ship criteria must be met prior to the submission of a software product to the Software Distribution Center (SDC) for shipment to customers. Before submission to the SDC, there is a 30-day "code freeze" period during which a product is installed, verified, and tested. Minimum ship criteria which must be met during this period include installing and verifying the code and publications, checking size, performance, and compatibility, and testing the product in intended market environments. Be sure to allow enough time during the development process for these criteria to be met. Consult the *Software Development Policies and Procedures Manual*, Section 7A3-1.A, for full particulars regarding the minimum ship criteria.

Software product quality extends far beyond developing programs with few bugs. Quality represents a multitude of factors often overlooked by people developing programs. Ultimately, it is how our products are perceived in the marketplace by the user. To this end, Digital is working toward improved user perceptions of installability, ease of use, human engineering, performance, maintainability, compatibility, and reliability.

3.0 SOFTWARE DEVELOPMENT PROCESS

The Software Development organization has developed processes for orderly and effective development and support of our software products.

The flow chart in Figure 4-1, entitled Software Product Life Cycle, depicts software development from many perspectives. It includes the six phases of product life, the people and groups (internal and external to Software Development) who plan, develop, test, promote, sell, and service the product. It also shows the documentation and reviews* required for software products throughout their entire life cycle.

Each phase of development has a particular set of activities, and in each a particular set of well defined events, called milestones, occurs. Usually the beginning and end of a phase are marked by milestones.

The six successive development phases are:

- 0 Strategy and Product Requirements
- 1 Product Plan Development
- 2 Implementation (including internal testing)
- 3 Product Qualification (field testing) and Release
- 4 Product Continuation and Exploitation
- 5 Product Retirement

Many groups of people are involved in the development process. The Product Manager is the chief coordinator of the development of a software product. He or she is responsible for coordinating the actual development (design and programming) with other activities which impact the product, e.g., Marketing, Sales, Training, Documentation, and Software Services. In general, the Product Manager ensures that all affected groups have an identified contact person for the project, and that those people are kept apprised of important information relating to the project and product.

Note that not all projects have a Product Manager, but every project has a Project Leader. If there is no Product Manager, the Project Leader must establish communication with other support groups (Marketing, Sales, Training, Documentation, and Software Services).

The Program Manager, sometimes called the System Manager, makes sure that all development activities run according to schedule. He or she is responsible for the integrity of the system. While the Project Leader coordinates activities internal and external to Software Development, the Program Manager is responsible for coordinating internal development activities.

The actual design and development of the product remain the responsibility of the Software Engineers on the development team. The developers should view the Product Manager as a valuable team member and primary resource for expediting communication with other groups in the corporation. But developers must always remember that they remain fundamentally responsible for the success of the product as measured by the quality of the design and the success of the implementation.

In the development of a software project, the activities of various groups are concurrent. Greatly simplified, these activities are:

*See Section 4, Paragraph 4.0 for information about the Phase Review Process.

SOFTWARE PRODUCT LIFE CYCLE
PROCESS FLOW
TECHNICAL ASSESSMENT
FINANCIAL PLANNING
INTERNAL TESTING
MANUFACTURING
END PHASE 0
BEGIN PHASE 1
END PHASE 1
BEGIN PHASE 2
END PHASE 2
BEGIN PHASE 3
END PHASE 3
BEGIN PHASE 4
END PHASE 4
BEGIN PHASE 5
END PHASE 5
PRODUCT STRATEGY & REQUIREMENTS DEVELOPMENT
PRODUCT PLAN DEVELOPMENT
PRODUCT IMPLEMENTATION & INTERNAL TESTING
PRODUCT FIELD TESTING & RELEASE
PRODUCT CONTINUATION & EXPLOITATION
PRODUCT MATURE & PRODUCT RETIREMENT PLANNING & IMPLEMENTATION

Group	*Activities*
Development	Plan, develop, test, package, release, and maintain a software product.
Software Quality Management	Represent user in-house by establishing quality goals, monitoring development activity, and assessing risk in shipping a software product.
Software Documentation	Write manuals for use by customers.
Software Distribution Center	Reproduce, stock, and distribute software and accompanying manuals.
Product Management	Manage the business aspects of a product throughout its life.
Software Services	Support customers in using a software product.
Educational Services, Software Services Training, Sales Training	Provide training courses for customers, employees, sales people and development personnel.

The software development process requires detailed documents at specified times. Consult the *Software Development Policies and Procedures Manual* for a complete list and description of all required documents. Four key documents are described below:

The *Project Plan* provides a conceptual overview of design objectives, an overview of required features both internal and external. It identifies interfaces with other projects and products, and it identifies all subsequent documentation requirements. It includes budgets, schedules, and staffing requirements. The Project Plan either contains the related plans or explicitly points to them. This document represents the commitments of the project.

The *Functional Specification* describes in detail the external characteristics of the software product. External characteristics are those observable to, or under the control of, the user of the product. All features of the system actively under the control of the user are defined. Those items which are only passively under user control, e.g., listing formats, diagnostic messages, etc., are described in sufficient detail to determine their applicability.

The Functional Specification is a design-to document and, as such, describes the product sufficiently for detailed design to commence. All hardware and software compatibilities, standards, compliances, dependencies, macro calls, interfaces, and files are identified as well as size and performance objectives. Furthermore, all known limitations or functional capabilities not implemented should be specified. This information should be sufficient for all support groups to proceed.

The *Design Specification* defines the internal design of a software product and becomes part of the Internal Maintenance Specification. It pinpoints the software technology involved and defines the internal structure and tables. It specifies intrasystem calls, delineates all interdependencies, and describes the method to be used for the implementation of the Functional Specification.

The Software Product *Business Plan* identifies and describes the software product to be developed, the goals and non-goals of the project, its assumptions and constraints, and the target markets and applications for the product. It also includes an analysis of the competition, technological considerations and implementations, and a tabulation of the total five-year schedule for all products in your development group. The Business Plan also includes a quantitative summary that details product life-cycle costs, unit sales by product, and the projected revenue by the product. Project funding sources are included along with future needs for development funding. Finally, the Business Plan includes a section which addresses the issues, risks, and contingencies which may have an impact on your project.

4.0 THE PHASE REVIEW PROCESS

The Phase Review Process is a method used to manage software products. The process defines phases of a product's life cycle, specifying the plans, activities, and documents necessary at each phase. It helps to ensure that the documents exist and have been reviewed by the appropriate people and groups. Phase Reviews correspond to the end points of phases in the development process.

The Phase Review Process is the formal mechanism that brings together participants from each key group to acknowledge that the project(s) should proceed as planned. The process also serves to identify actions and responsibilities necessary to resolve issues that prevent a project's continuation.

The Phase Review Process is required for all software products and programs funded by Central Engineering.

The Product Manager, or in some cases, the System Manager, calls the meeting, chairs it, and documents the minutes within one week of the meeting. He or she then sends copies of the minutes to all attendees. Two weeks notice must be given to all attendees of a forthcoming meeting.

The Phase Review Process helps the Product Manager to:

- Coordinate strategies, plans, schedules, services, etc.
- Monitor all technical and support activities connected with a product's development to ensure that the product meets the functional requirements of the marketing organizations (Product Lines) and is consistent with their strategies
- Provide a return-on-investment calculations for approval of expenditures

The Phase Review Process monitors the status of a product during its entire life cycle. Product life consists of six phases (these are the same as the development phases), each with definite, associated activities. The descriptions of the phases which follow are intended only as brief overviews, and not complete lists of activities. Consult the *Software Development Policies and Procedures Manual*, Section 5D2-1A, for a complete list of documents and activities reviewed, people and groups involved, decisions made, and action taken following each Phase Review meeting.

Phase 0 Strategy and Product Requirements

The purpose of this phase is to explore and define a potential product or product enhancement by evaluating its technical, financial, and marketing implications. In some instances, a study is prepared to determine the project's feasibility. Development, Maintenance, Quality Assurance, and Documentation requirements are developed. Also developed are requirements for Educational Services Training, Software Services, Sales Training, and Advertising. A Software Distribution Center (SDC) Resource Impact Analysis is also prepared.

Phase 1 Product Plan Development

The purpose of this phase is to develop firm definitions of the product concept and to prepare the product and supporting activity plans. At the completion of this phase, groups are committed to product and support schedules, expense plans, design requirements, business forecasts, and distribution plans.

Phase 2 Implementation (including internal testing)

The purpose of this phase is to design and implement the product as committed with supporting services according to plan. Visible demonstrations, reports, test results, project reviews, etc., are compiled to provide confidence that the product meets the performance specification.

Phase 3 Product Qualification (field testing) and Release

The purpose of this phase is to confirm that the product meets the technical, market, and support objectives by external testing. Product announcements cannot be made until such a determination is made. Once the release criteria have been met, the Software Distribution Center (SDC) proceeds with software manufacture and customer distribution.

Phase 4 Product Continuation and Exploitation

The purpose of this phase is to continue monitoring the sales, maintenance, and delivery of the product. The product's profitability to the corporation is reviewed. Future enhancements to the product are planned based on market activity.

Phase 5 Product Retirement

Typically, this phase is considered as the Phase 0 of the replacement or enhancement product. When a product does enter this phase, action is initiated to retire the product from the market by reducing the support category and price. Shipment continues or the product is withdrawn from the Software Distribution Center (SDC).

A Phase Review meeting marks the end of each of the phases (a major change in strategy or market requirements is also cause for convening a phase review meeting). At the review meeting, participants and observers consider all aspects of the product's status and decide if the product should proceed to the next phase. Criteria for moving a product into the next phase include:

a. The satisfaction that all of the requirements for the present phase have been fulfilled
b. The acknowledgement of commitments from organizations involved in the next phase

The following table illustrates the documents and activities to be signed off by the responsible people and groups during each phase of the Phase Review process. A full list of attendees, decisions, and actions at each Phase Review meeting is contained in the *Software Development Policies and Procedures Manual*, Section 5D2-1.A.

Table 4-1 Documents/Activities for Phase Review Meetings

DOCUMENT/ACTIVITY	*PHASE*	*WHO SIGNS OFF*
Market Requirements & Product Requirements	0 0	Product Line Mgrs & Product Mgr
Preliminary Project Plan(s)	0	Documentation Mgr & Product Mgr
Preliminary Business Plan	0	Product Mgr
Product Plan Project Plan(s), final	1	Product Mgr, Documentation Mgr, Development Mgr, Standards Rep, Software Quality Mgr
Project Authorization Forms	1	Product Mgr, Documentation Mgr, Development Mgr, Financial Rep
Functional Specs, final	1	Development Mgr, Product Mgr, Standards Rep, Software Quality Mgr
RAMP Plan	1	Development Mgr, Software Services, Software Quality Mgr
Q/A Plan, final	1	Development Mgr, Software Quality Mgr
Preliminary Support Plan	1	Product Mgr, Development Mgr, Software Services, Software Quality Mgr
Preliminary Training Plan	1	Product Mgr, Development Mgr, Software Services, Software Quality Mgr
Preliminary Promotion and Introduction Plan	1	Product Mgr, Development Mgr, Software Services
Internal Test Plan, final	1	Product Mgr, Development Mgr, Standards Rep, Software Quality Mgr
Preliminary Field Test Plan	1	Product Manager, Software Services, Software Quality Mgr
Preliminary Documentation Plan	1	Development Mgr, Documentation Mgr, Software Quality Mgr
Business Plan, final	1	Product Mgr
Preliminary Migration Plan	1	Product Mgr

DOCUMENT/ACTIVITY	*PHASE*	*WHO SIGNS OFF*
Software Product Description, final	2	Product Mgr, Software Quality Mgr
Release Plan, final	2	Product Mgr, Software Distribution Center
Pricing Plan, final	2	Product Mgr, Product Line Marketing Comm
Sales Training Plan, final		Product Manager, Sales Training
Internal Test Results Review	2	Product Manager, Development Mgr Software Quality Mgr
Field Test Plan, final	2	Development Mgr, Product Mgr, Documentation Mgr, Software Services, Software Quality Mgr
User Documentation, final draft	2	Product Mgr, Development Mgr, Documentation Mgr, Software Quality Mgr
Documentation (for Software Support),	2	Product Mgr, Development Mgr, final Software Services
Support Plan, final	2	Product Mgr, Development Mgr, Software Services, Software Quality Mgr
Training Plan, final	2	Product Mgr, Development Mgr, Educational Services, Software Services, Software Quality Mgr
Software Distribution Center Plan		Product Mgr, Development Mgr, Software Distribution Center
Sales Update Article, final	3	Product Mgr, Software Quality Mgr
Digital Software Dispatch Article, final		Product Mgr, Software Quality Mgr
Field Test Results Reviewed		
Software	3	Development Mgr, Product Mgr, Software Services, Software Quality Mgr
Documentation	3	Development Mgr, Documentation Mgr, Software Quality Mgr

DOCUMENT/ACTIVITY	*PHASE*	*WHO SIGNS OFF*
Installation	3	Software Services, Development Mgr, Software Quality Mgr
Customer Training Services	3	Product Manager, Educational
Software Distribution Center Plan, finalized and approved	3	Product Mgr, Software Distribution Center
Sales Training Complete	3	Product Mgr, Sales Training
Entire Product Verification Completed	3	Product Mgr, Documentation Mgr, Software Quality Mgr
Product Post-Release Evaluation Plan Finalized	3	Development Mgr, Software Services, Product Mgr, Software Quality Mgr
Software Product Description Approved	3	Development Mgr, Software Services, Product Mgr, Software Quality Mgr
Minimum Ship Criteria	3	Development Mgr, Product Mgr, Software Services, Documentation Mgr, Software Quality Mgr
Release Plan Approved	3	Product Mgr, Development Mgr, Software Distribution Center
Product Evaluation	4	Product Mgr, Software Services, Development Mgr, Documentation Mgr, Software Quality Mgr
Preliminary Retirement Plan	4	Product Mgr, Product Line Marketing Committee
Product Retirement Plan, final	5	Product Mgr, Product Line Marketing Committee

The *Software Development Policies and Procedures Manual* will change as we change or gain a better understanding of our operation. It is quite possible that you, in your work at Digital, may be directly or indirectly involved in formulating or updating these policies. All the policies and procedures serve one overall purpose: to make it easier for all of us to exchange information that will help us produce top quality Digital software products.

SECTION 5

OFFICE OF DEVELOPMENT/ENGINEERING

As a new engineer you will often need to contact Engineering groups outside your local domain for assistance and services. The following pages describe the functions of various Engineering groups. Information is provided to help you determine when to contact a group and who to contact. Ten organizations make up the core of Engineering at Digital.

1.0 Computer Systems Development

2.0 Software Engineering

3.0 Technical Operations

4.0 Systems Architecture and Technology

5.0 LSI Manufacturing and Engineering

6.0 Storage Systems Development

7.0 Distributed and Mid-Range Systems Development

8.0 Large Systems Product Development

9.0 Corporate Research Group

10.0 External Resources

1.0 COMPUTER SYSTEMS DEVELOPMENT
Manager: Dick Clayton (ML1-2/E60, 223-3638)

1.1 PLANNING AND PRODUCT MANAGEMENT
Manager: Stan Pearson (ML12-2/E71, 223-2424)

This organization provides product management, product marketing, and strategic product planning for LSI products, video and hard copy terminals, and small hardware systems. They manage the processes by which these products are developed, announced, and introduced to the marketplace. The organization prepares and obtains formal approval for integrated product plans. They regularly mea sure progress against these plans, taking corrective action as required to preserve the objectives of each plan. Planning and Product Management also generates pricing strategies, and prepares sales updates to introduce new products or make changes to existing ones.

Product managers for products developed within Computer Systems Development are listed below.

LSI	Dick Loveland (ML12-2/E38, 223-7107)
Terminals	Ed Lazar (ML1-2/E29, 223-8927)
Small Hardware Systems	Ted Webber (ML1-2/E29, 223-7155)

1.2 LSI (LARGE SCALE INTEGRATION) DEVELOPMENT
Manager: Roy Moffa (ML1-2/H26, 223-3295)
Development Manager: Mike Titelbaum (ML1-2/E65, 223-3477)

This group manages the identification, specification, and development of PDP-11 MOS microprocessor chips and support chips for microprocessors (the LSI-11/23 and others).

The group consists of three technology development teams headed by Duane Dickhut (ML1-2/E65, 223-4304), Michel Depyrot (ML3-3/B91, 223-2996), and Bob Supnik (ML1-2/E65, 223-9439).

Questions about specific applications of microprocessor devices should be directed to the team managers above, Mary Ellen Lewandowski (ML1-2/E65, 223-6523), or Mike Phipps (ML1-2/E65, 223-4274). These individuals can help you focus on controller or system applications for the best use of designed microprocessor chips.

Additionally, contact Maurice Marks (ML3-5/E82, 223-2679) about microprocessor software and hardware development tools, and Gerry Dulaney (ML1-2/E65, 223-8574) about the availability of microprocessor chips. Questions concerning the MOS process or circuit design should be directed to the Microproducts group.

1.3 ADVANCED LSI ARCHITECTURE
Manager: Steve Teicher (ML4-3/T34, 223-3175)

The task of the LSI Architecture group is to work with engineers from Small Hardware Systems and LSI Development to develop a set of plans for building a 32-bit system that uses a LSI chipset. Once the chipset plans are in place, the group will specify other elements of the system, including storage systems, packaging, and communications.

1.4 TERMINALS

Manager: Dick Clayton (acting), (ML1-2/E60, 223-3638)

This group designs and develops both video and hard copy, high-volume, terminal-oriented products. Such products include the VF100, LA34, LA120, etc. The group focuses on advanced development, product development, corporate level product support, and planning for terminals strategy. The group's products require some of the highest volume electromechanical and plastics tooling in Digital. The group regularly supplies a customer level product design to Manufacturing. They also supply basic terminal components to which other groups add some function or specific application.

Contact the group for solutions to problems associated with designing, manufacturing, or using Digital's high-volume terminal products.

1.4.1 Terminals Technical Integration

Manager: Dick Clayton (acting), (ML1-2/E60, 223-3638)

This group provides technical leadership and management for common terminal components and architectures. Problems or requirements for keyboards, terminal communication features, standards, etc., associated with high-volume terminal products are handled by this group.

1.4.2 Hard Copy Terminals

Manager: Art Williams (ML1-3/E62, 223-3954)

This group designs printer terminals, including keyboards, heads; mechanisms, and packages, and is responsible for high-volume buyout line printers. They work closely with Manufacturing and Marketing.

Contact group members when you want advice about selecting specialized products, or if you need help in modifying a terminal. Group members can also evaluate vendor terminals (e.g., printers and card readers) that you may be planning to acquire.

Other groups within Hard Copy Terminals Engineering include:

Group	*Manager*
LA 34 Products	Frank Digilio (ML1-3/E62, 223-3778)
LA 120 Products	Paul Nelson (ML5-3/E12, 233-3528)
VT 162 Products	Dick Brewer (ML5-3/E12, 223-8448)

Printer Engineering Advanced Development, headed by Walt Tetschner (ML5-3/E12, 223-6788), performs technical explorations which support printer product development. Some examples of the work performed by this team include new keyboard technology, alternate printing technologies (thermal, electrosensitive, and electrophotographic), and extensions of impact matrix printing.

Contact group members during the planning and concept stages of your project with a description of your product plans and needs.

1.4.3 Video Development

Manager: Len Halio (ML1-2/H26, 223-5687)

This group designs and develops video products that can either serve as entry-level devices or be upgraded to more sophisticated systems. The group has three areas of concentration: video display terminals, advanced terminals, and graphics. Contact the team leaders or the group manager when you are building or modifying a video terminal, or when you need general information on video or graphic architectural techniques.

The *Base Video* team, headed by Craig James (ML1-2/H26, 223-3915), is responsible for the design and development of interactive video display terminals. The VT100 video terminal that is presently offered is basic, i.e., it lacks intelligence. However, it has many features not found on competitive entry-level terminals, and it can be upgraded to higher levels of capability.

The *Advanced Terminals* team, headed by Len Halio (ML1-2/H26, 223-5687), is responsible for developing a new family of programmable, terminal-based systems.

The *Graphics Terminals* team, headed by John Elsbree (ML1-2/H26, 231-6939), is responsible for video-based graphics devices that include graphic terminals, graphic architecture, and ancillary graphic devices.

1.5 SMALL HARDWARE SYSTEMS DEVELOPMENT

Manager: Herb Shanzer (ML1-2/E60, 223-5159)
Development Manager: Avram Miller (ML1-2/E60, 223-9441)

Small Systems Development is responsible for systems products which sell for 16K or less. This includes the 11/23, 11/03 and PDT 150, PDP-11 based systems, and all PDP-8 products. Design responsibility includes not only the specific CPU hardware, but integration of complete systems offerings including software, peripherals, and packaging.

1.5.1 PDP-11 Systems Development

Manager: Lou Klotz (ML1-2/E60, 223-3471)

The PDP-11 Systems Development group develops 11/03, 11/23 and PDT systems, and Q-bus options that are of a cross-product nature, or that have sufficient product line volume to support central engineering development. The team supports existing LSI-11 products and is involved in advanced products that include system development and custom LSI development of both CPUs and special function controllers.

1.5.2 PDP-8 Systems Development

Manager: Paul Gardner (ML1-2/E60, 223-5937)

The PDP-8 Systems Development group is responsible for all PDP-8 products, integrated systems such as the VT-78 and Omnibus, and Micro-8 products. They develop new PDP-8 products and bounded systems, support existing products, and provide engineering support to product lines developing PDP-8 based products.

1.5.3 Mechanical Design/Advanced Development

Manager: Dick Gonzales (ML6B-2/E66, 223-4822)

This group provides mechanical engineering support in the development of products by Small Systems and Video Products. They also offer their services companywide for non-standard applications, i.e., the development of a single product for one product area or product line.

Group members stay abreast of new design techniques that might facilitate development of new products. They engage in advanced development of electromechanical devices and packaging techniques. They perform value-engineering reviews in accordance with DEC Standard 007. In addition, the group seeks to establish leadership and direction in plastics technology and its application.

Contact Dave Boudreau (ML6B-2/E66, 223-2257) if you want information about plastics technology or if you are interested in the direction of Digital's involvement in plastics fabrication.

1.5.4 Advanced Development

Manager: Russ Moore (ML1-2/E60, 223-4676)

This group is responsible for investigation and predesign studies on those systems issues which are crucial to our next generation products. Areas of activity include working with the CPU chip development group, bus structures and implementation, self-installability and ease of use, and packaging and manufacturing issues.

1.5.5 Small Systems Diagnostic Engineering

Manager: Dan Casaletto (ML21-4/E10, 223-3618)

This group (SSDE) supports the product development activities of Small Systems and Video Products. Specific products supported include PDP-8 and low-end PDP-11 CPUs, peripherals, and systems. The group also supports video and hard-copy terminals, printers, and LSI microprocessors.

This support includes hardware design consultation (for testability), micro coding skills, design verification, and prototype debug support for hardware engineering. The group provides unit, subsystem, and system test software to Manufacturing. They also provide repair, installation, preventive maintenance, software, and software packages to Field Service.

Small Systems Diagnostic Engineering provides testing for all hardware from the unit level through systems test. To accomplish this, SSDE works with other diagnostic engineering groups responsible for chip testing, automated program load system for Manufacturing, and system test tools.

2.0 SOFTWARE ENGINEERING

Manager: Bill (B.J.) Johnson (ML12-3/A62, 223-3982)

2.1 REAL-TIME/COMPUTATIONAL (RT/C) SOFTWARE SYSTEMS

Manager: Bill Heffner (TW/E10, 247-2701)

This organization develops competitive real-time and computational software products. They provide other Digital groups with base-level software systems on which these groups can build products. The RT/C organization includes four product development groups that design, implement, maintain, and enhance software products. Also included are product and quality management groups, and a publications group that develops user documentation.

Descriptions of these groups follow. Contact the appropriate group when you need information about products being planned or developed. Additionally, contact them when you identify future requirements that can be met by this organization's expertise.

2.1.1 Base Systems Quality Management
Manager: Brad Glass (TW/E10, 247-2700)

This group is responsible for software quality program definition and implementation for base systems software. Group activities include quality and test planning, all software field tests, product assurance, test systems development, and performance measurement of the VAX/VMS, RSX, and Small Systems (RT-11, FMS-11, etc.) software.

The group's emphasis is on providing a user-oriented, quality perspective of software development activities.

2.1.2 Software Product Management
Manager: John Rose (TW/E10, 247-2171)

This group is responsible for assessing the needs of the marketplace and defining what products (or enhancements to products) are required for the marketplace, and determining what proportion of money should be spent in each area of the Base Systems Software organization to accomplish their goals.

Product Management is also responsible for developing and tracking product business plans, and for initiating promotional activities in support of Product Lines and Sales. Product Managers are also responsible for orchestrating the Phase Review Process. All of these activities are accomplished with the support of many persons in groups throughout the corporation. Having limited resources of its own, Product Management is primarily an initiator, motivator, participant, and organizer of the above activities.

2.1.3 Small Base Systems Software
Manager: Gil Steil (ML5-5/E76, 223-5150)

The Small Base Systems Software group specifies, designs, implements, tests, and supports small real-time operating systems, intelligent terminal software, chip and board software, BASIC and PASCAL language implementations, all PDP-8 software (except word processing and typeset), some terminal firmware, and special, directly-funded software products.

The group also produces and manages the system plans for PDT-11 software, firmware, micro-computer software, and RT-11 software.

2.1.4 VAX/VMS Systems Development
Manager: Joe Carchidi (TW/D08, 247-2251)

This group develops and maintains operating system software for the VAX-11 family of computer systems. The software is general enough to serve as the base system for all market-oriented VAX-11 software products.

The group is also responsible for ensuring that all VAX-11 software products are perceived by customers as part of one, high-quality product offering. In some cases, they control the integration and release process for software.

2.1.5 RSX Systems Development
Manager: Frank Hassett (TW/C10, 247-2151)

This group develops, produces, and maintains a comprehensive and competitive set of real-time products as well as common base systems upon which other Digital products can be built. RSX Systems are concerned primarily with operating systems. However, the group works to ensure a total product set. In other words, the individual real-time products support auxiliary software products (including languages, networks, and data base management systems) so that the combination constitutes a competitive set.

The group is also responsible for the Record Management System (RMS) software for RSX, IAS, VMS, and RSTS systems.

2.2 COMMERCIAL ENGINEERING
Manager: Bob Daley (MK1-2/H03, 264-6183)

Commercial Engineering has a number of development functions, many of them software, some hardware. The organization's primary mission is to make high quality commercial systems and products a reality within Digital's total commercial market place. Thus, the organization's focus is on total program/system implications and integration issues, as well as life-cycle costs. To implement this objective, the organization translates commercial market requirements into integrated system strategies for centrally developed products. Commercial Engineering is responsible for the success of these products.

The organization's major developmental efforts are in commercial small systems, commercial timesharing systems, transaction processing systems, data base and data management, languages, compilers, and application software. Various groups also develop tools and methodologies, carry on program management, and coordinate and integrate all of Digital's centrally developed commercial systems and products, as well as those applications of interest to specific product lines.

Groups engage in such activities as coordinating and optimizing technical activities between product line engineering and Central Engineering groups, conducting schedule reviews, and communicating system, program, and product development activities to various product lines. The organization encourages the development of an environment that allows for cooperation among all groups oriented toward commercial engineering.

Brief descriptions of the five groups within Commercial Engineering follow. Contact the appropriate group managers when you have questions concerning their respective areas of expertise.

2.2.1 Software Quality Management
Manager: Ed Spuler (MK1-2/C02, 264-6720)

This group establishes objective, quality assessments for all products produced within Commercial Engineering. The group's responsibility also extends into other areas of the company on which Commercial Engineering depends for sub-systems and layered products.

The group also establishes methodologies for testing products, and quality metrics that can be used during the development cycles to help build quality into all Digital products.

Quality extends beyond the range of development. The group also ensures for quality through the maintenance of existing products, service in support of those products, and training, promotion, and sales efforts.

Specific to the development process, Software Quality Management monitors and participates in schedule reviews, the phase review process, field tests, and the verification and validation of final product specifications.

2.2.2 Commercial Systems & Information Management

Managers: Doug MacLean (MK1-2/H3, 264-6167)
Fred Howell (MK1-2/H3, 264-6023)

This group is responsible for information management and general purpose systems for commercial data processing. To carry out these responsibilities, the group develops certain software products and provides strategy and program management for development work performed by other engineering groups.

There are two major programs for which the group is responsible, Corporate Information Management Strategy and the Commercial VAX program. The group develops such products as DBMS, Datatrieve, RSTS/E, and Commercial Application/Terminal Support (CATS).

Contact this group on any of the following topics:

- Current or planned capabilities of any of the products listed above
- Hardware support of the RSTS/E operating system
- Commercial data processing capabilities of VAX and VAX/VMS systems
- Corporate Information Management Strategy

The Commercial Systems & Information Management group can provide you with project plans, functional specifications, technical strategy documents, and related materials.

2.2.3 Commercial Applications Systems

Manager: John T. Morgan (MK1-2/A08, 264-5672)

This group builds and supports software application systems, application packages, and application development tools. They also support certain mature software systems. To perform these activities, the group builds applications and customer application development aids using layered products and base systems.

The group develops interactive information processing systems and transaction processing systems (TRAX products, TMS-11, CMS-11, CPMS-11, TABS-11/ICS) on PDP-11 and VAX-11 processors. These processors are capable of terminal configurations which are used in such industries as newspaper publishing, manufacturing, and transportation.

Their application packages (e.g., ASSIST-11,) are interactive products installable on standard PDP-11 and VAX-11 systems. These products are used for such functions as telephone operator directory assistance and newspaper control.

The group also develops application development systems and tools to be used by customers for applications in their own environments.

2.2.4 Commercial Hardware Systems Engineering
Manager: Brian Fitzgerald (MK1-2/H32, 264-5553)

This group is responsible for the design, development, and support of PDP-11 and VAX-11 based hardware computer systems and related products that are used in commerical applications. Commercial computer configurations are designed around standard products developed by other engineering groups which conform to the corporate engineering strategy and design standards.

Commercial Hardware Systems Engineering integrates the appropriate corporate products and designs additional equipment as necessary to support commercial market requirements. This work may be accomplished directly, or through the services of other engineering organizations.

2.2.4.1 Diagnostic Engineering - Merrimack
Manager: Bob Misner (MK1-2/B06, 264-5949)

This group develops hardware diagnostic programs for peripherals developed or supported by engineering groups in Merrimack. These groups presently include Communications Engineering, Graphic Arts Engineering, Business Products Engineering, and Word Processing Engineering. Additionally, the group develops hardware diagnostics for Merrimack's turnkey and packaged systems.

The Merrimack Diagnostics group develops on-line diagnostics in support of any operating systems or special application packages engineered in Merrimack.

Programs developed are used for engineering design verification, Manufacturing (high-volume Final Assembly & Test), and Field Service.

2.3 10/20 SYSTEMS AND CORPORATE LANGUAGES
Manager: Dick Snyder (MR1-2/E37, 231-5062)

This organization develops virtually all languages for Digital's computers, from the PDP-11 through the largest DECsystem 10/20. There are primarily two divisions within the organization, Technical Languages and Commercial Languages. Additionally, the organization is composed of a 10/20 Operating Systems and Data Management group, and a Software Quality Management group.

2.3.1 Technical Languages
Manager: Norma Abel (MR1-2/E37, 231-6279)

The Technical Languages group is responsible for the compilers and object time systems for the PDP-11, VAX, and DECsystem 10/20 for "technical" languages. These languages include FORTRAN, APL, and PASCAL.

The group is located at two sites, Marlboro and Tewksbury. Bill Page (TW/C10, 247-2175) heads the Tewksbury group.

2.3.2 Commercial Languages
Manager: Jeff Rudy (MK1-2/J5, 264-6680)

This group develops and maintains language processors for several different computer languages. The languages are generally those that have industry-wide appeal in the development of commercial applications, although they are not limited to that area. Such languages include BASIC+2 and COBOL.

The group is also involved in the development of key utilities applicable to the use of compiler languages. These include SORT, VAX, Common Run-time Library, and the DEC Standard Editor.

They also address issues related to compatibility both within Digital and industry wide. Members of the group hold positions on numerous industry, architecture, and company standards committees.

Contact this group on questions or issues related to the products listed above. Commercial Languages can also provide more information regarding Standards in the areas of BASIC or COBOL languages, and the DEC Standard Editor.

2.3.3 10/20 Systems Software

Manager: Ron Criss (MR1-2/E37, 231-5243)

The 10/20 Software Systems group has within it the Operating Systems Group and the Data Management Group.

The Data Management Group is responsible for DBMS 10/20, RMS, and Macro/Link.

The Operating Systems Group, managed by Peter Hurley, (MR1-2/E37, 231-6183), includes:

The TOPS-10 team, supervised by Craig Fletcher (MR1-2/E37, 231-5008), is responsible for TOPS-10 monitor and TOPS-10 support utilities.

The TOPS-20 team, supervised by Sumner Blount (MR1-2/E37, 231-6328), is responsible for TOPS-20 monitor and TOPS-20 support utilities.

The GALAXY team, supervised by Larry Samberg (MR1-2/E37, 231-6338), is responsible for the BATCH, spooling, and network utilities for both DECsystem-10 and DECSYSTEM-20 products.

The Release Engineering team, supervised by Arthur Zina (MR1-2/E37, 231-5116), prepares DECSYSTEM 10/20 software for release to the Software Distribution Center (SDC). The team also ensures that components for 10/20 software products are complete and consistent for general release.

2.3.4 Software Quality Management

Manager: Richard Glantz (MR1-2/E37, 231-6031)

Software Quality Management ensures that for every high-volume software product developed in Marlboro:

- quality levels are specified in advance
- project plans offer a reasonable certainty of attaining these quality levels
- compatibility exists between customers' expectations and the commitments made by Software Engineering
- final products can meet their projected quality goals
- there is a process for gathering and introducing customer opinion into the overall development cycle

The group participates in the Phase Review process where problems can be discerned at an early stage before they become expensive problems. Members participate in the quality assurance segment of project plans, and both plan and monitor load test, field test, and release metrics.

2.4 SOFTWARE PUBLICATIONS

Managers: Norm Brimhall (ML5-5/E39, 223-4576)
Steve Heiser (MR1-2/E37, 231-5343)
Jim Padian (MK1-2/H03, 264-6816)
Armen Varteressian (TW/A14, 247-2056)

Software Publications is located in Maynard (Distributed and Mid-Range Systems), Marlboro (10/20 Systems), Merrimack (Commercial Engineering), and Tewksbury (Base Systems Software).

Composed of writers, editors, and production people, these groups are responsible for generating and maintaining software manuals for customers at all levels of experience. Members of the groups possess literary, technical, and production skills. Collectively their responsibilities include the planning, organization, completeness, accuracy, appropriateness, readability, and appearance of software publications.

To effectively design a software manual, groups gather information from software and hardware engineering, the product lines, software quality management, Software Services training, DECUS, and visits to customer sites.

These groups maintain a close professional relationship with other document-producing groups within Digital to promote compatibility, consistency, and uniformity among software and hardware manuals.

2.5 APPLICATION SYSTEMS GROUP

Manager: Ollie Stone (ML21-3/E87, 223-6617)

This group develops hardware and software application systems for the Retail Products Group, the Telephone and Utilities Group, other product lines, Manufacturing, Field Service, Engineering, and other organizations. As a systems engineering resource, Application Systems supports their systems by providing training, bug fixing, consultation, and other similar services.

Most of this group's application systems require high availability and reliability. These applications represent major investments in hardware and software development. For this reason, predictability of costs and schedules is imperative. To ensure such predictability, the group follows a written agreement on project functionality. The development process also ensures a continuous review of market requirements, resulting in high quality systems which are both on-time and within the budget.

Most of the projects undertaken by the group involve a PDP-11 as the base computer, and usually RSTS and BASIC+ as the base software, sometimes using RT-11 or RSX. The group has done some DECsystem-10 development and will be involved in numerous PDP-8 systems this coming year. Other expertise ranges from micro assembler (8080, 2901), through macro, to high level languages (FORTRAN, COBOL, PL/I).

The group has three teams which provide service in specific areas. Contact the managers listed below for more information.

Customer Applications — Tom Hayden (ML21-3/E87, 223-4408)

Internal Special Systems — Eve Bartis (ML21-3/E87, 223-2126)

Retail Products Development Gary Cole (MK1-1/A06, 264-7478)
Jack Lockhart (MK1-1/A06, 264-7487)

2.6 SOFTWARE ARCHITECTURE AND TOOLS

Manager: Bill Keating (ML12-3/A62, 223-7773)

This group is responsible for the management and coordination of Software Architecture. They own various architectural processes and provide technical leadership to resolve key strategic and implementation issues within Software Development. In addition to coordinating various software advanced development activities, the group provides tools and other means to improve the effectiveness of software development.

Contact the group for solutions to major software architectural problems. The group will also help you understand the process in place, and take suggestions relative to software advanced development.

2.6.1 Base Systems, Architecture, and Interface Management

Manager: Bob Bellman (ML12-3/A62, 223-5315)

This group creates and administers Base Systems and Interface Management Policies which govern the development of certain base system software, software layered on top of those systems, and software supporting key interfaces. The group also assists in the development of major software architectures, particularly those that require inter-organizational efforts.

Contact this group for assistance in planning projects that may affect base systems or key interfaces, in coordinating inter-organizational software projects, and in developing architectures in such areas as data management or distributed processing.

2.6.2 Hardware/Software Coordination

Manager: Jim Kapadia (ML12-3/A62, 223-7463)

This group is primarily responsible for coordination and planning between hardware and software. They try to minimize disjointed planning between the two by facilitating and influencing compatibility among plans, strategies, and activities. They also help resolve issues common to both hardware and software by providing a common point of interaction. The group addresses global issues impacting hardware and software, and over the long range, provides needed decisions for smooth and efficient cooperation between the two.

Contact this group when there is an inconsistency between hardware and software plans (e.g., release dates, funding, support, etc.), products (e.g., design, architecture), strategies, or activities. The group will facilitate communication between the appropriate individuals and help resolve the issues. Proper visibility and focus will be provided to help achieve resolution.

2.6.3 Software Methods And Tools

Manager: Bill Segal (ML3-5/E82, 223-2433)

This group promotes the use of proven, state-of-the-art software engineering methods where applicable within Digital. They also develop and support tools for software engineers with a primary focus on increasing productivity and software quality and descreasing software life-cycle costs.

The Methods and Tools group will provide specific software tools along with documentation, training, and support as needed. Additionally, the group is interested in consulting on any area within their expertise such as implementation languages, debuggers, text processors, and software methodology.

Contact the group for information or support on any of the following:

- BLISS Compilers and Utilities
- DEC Standard RUNOFF
- Debuggers for VAX and PDP-11
- DIAMOND (Performance Measurement System)
- Electronic Mail System (DEC MAIL)
- Magnetic Tape Interchange
- Microfiche Utilities
- Documentation Tools
- Program Library Tools
- Transportable Software
- Software Methodology
- BLISS and MACRO-11/780 Coding Conventions

3.0 TECHNICAL OPERATIONS

Manager: John Holman, (ML12-2/T36, 223-5533)

3.1 POWER AND PACKAGING SYSTEMS

Manager: Phil Tays, (ML11-4/E53, 223-4144)

Power and Packaging Systems provides Engineering and Manufacturing groups with many key services. Groups within Power and Packaging Systems design power supply, power distribution, and power conditioning systems. They design and develop product packaging, conduct physical testing in six specific laboratories, and design Digital's products with attention to human factor analyses and product aesthetics. Power and Packaging Systems also tracks U.S. and international regulatory requirements.

3.1.1 Power and Packaging Product Management

Manager: Joe Smith, (ML8-3/T13, 223-8793)

This organization has product management responsibilities for many of the power supplies and cabinets developed by Power and Packaging Systems. They act as an intermediary among the entire group and outside organizations when one or more services are needed.

Product Management can help you determine hardware availability for power supplies and mechanical enclosures. They can also help you prepare business plans and proposals for hardware development.

Contact this group to gain an understanding of the existing families of packaging products which may apply to your design. To meet new power and packaging requirements, contact Product Management as early as possible in the product concept phase.

3.1.2 Packaging Development and Support
Manager: Jim Lawrence, (ML8-3/T13, 223-6744)

These groups are involved with the design, development, and support of mechanical interconnections, cabinets, packaging enclosures, shipping packages, and packaging test equipment. They evaluate heat transfer and acoustical performance, packaging materials, and are responsible for the Central Engineering environmental testing facilities. The individual groups which follow form the bulk of the organization and perform the indicated functions.

3.1.2.1 Interconnection Hardware Development
Manager: Jim Lawrence, (ML8-3/T13, 223-6744)

The development and support of interconnection products like connectors, cables, and device packaging are the primary responsibilities of this group. They also devise new backplane techniques and high-power connectors. The group monitors information about new materials, often evaluating the materials, and distributes information about their applications and reliability. Additionally, Interconnection Hardware Development assists in the development of the wet-process for printed circuit fabrication.

Contact this group during the concept stage of your project if you need their assistance.

3.1.2.2 Central Mechanical Engineering
Manager: Don Staffiere, (ML11-4/E53, 223-8656)

This team develops and implements new mechanical packaging concepts in cabinets and enclosures. Members design, develop, and maintain cross-product enclosures. Furthermore, they upgrade and modify existing products to meet evolving international safety and regulatory requirements; they analyze, evaluate, and resolve problems identified by Field Service and Manufacturing that relate to existing mechanical enclosures. They also support the manufacturing process for mechanical assemblies. Additionally, the team develops guidelines and standards for cabinet cabling and stability. They also work with Thermal Engineering to establish cooling guidelines for enclosures.

Team members also serve in a central mechanical engineering resource pool to assist in the development of new products on a project-by-project basis. They furnish consultation on packaging design problems encountered by other groups. Finally, mechanical engineering expertise on test equipment mechanical design, burn-in chamber design, and the mechanical packaging of power supplies is also provided.

3.1.2.3 Environmental Engineering
Manager: Frank Grimaldi, (ML8-3/T13, 223-4177)

Environmental Engineering supplies mechanical engineering consultation, and maintains testing services in the following areas:

Acoustics - product acoustic noise
Climatics - temperature, humidity, altitude
Dynamics - vibration, mechanical shock
Heat Transfer - product cooling, air flow
Statics - physical stability

Environmental Engineering personnel function as contracted members of new product design teams to help develop quality products that meet required environmental performance capabilities. They are also active in performing advanced development tasks, maintaining DEC Standard 102, Environmental Standard for Computers and Peripherals, developing design guidelines, and tracking external regulations.

Environmental Engineering consists of three subgroups, (1) Product Acoustics, (2) Environmental Test, and (3) Thermal Engineering. Each group maintains and operates laboratory facilities to support area activities.

Contact this organization as early as possible, preferably in the concept stage of your project, before mechanical design or project factors are frozen.

3.1.2.4 Central Labs

The Power and Packaging Central Laboratories, located in the Maynard Mill, provide a central source of physical testing capabilities to support all areas of the corporation.

Individual laboratories, whose capabilities and operations are the responsibility of area experts within Power and Packaging, currently consist of the following:

Laboratory	*Power/Packaging Group*	*Manager*
Acoustics	Environmental Engineering	Bob Lotz, ML8-3/T13, 223-5774
EMI/RFI	Electromagnetic Compatibility	Pete Boers, ML11-3/H19, 223-5452
Environmental	Environmental Engineering	Frank Grimaldi, ML8-3/T13, 223-4177
Materials	Interconnection Engineering	Jim Lawrence, ML8-3/T13, 223-6744
Package Sample Making	Industrial Package Engineering	Larry Nielsen, ML8-3/B96, 223-2588
Thermal Engineering	Environmental Engineering	Robert Hanneman, ML8-3/T13, 223-3349

A broad spectrum of testing services is available. If internal capabilities are insufficient for a specific need, laboratory personnel can identify outside facilities and arrange for testing there.

3.1.2.5 Industrial Packaging

Manager: Larry Nielsen, (ML8-4/B96, 223-2588)

This group designs shipping packages for many different applications. They create package designs for shipping piece parts between facilities, package designs for shipping sub-assemblies, and package designs for moving products within a facility. They also create package designs for products purchased from vendors, package designs that serve the needs of Field Service support, and package designs for shipments to customers.

Industrial Packaging also works closely with Purchasing to evaluate new packaging materials for use by Digital. They evaluate vendor packaging, and build prototypes of new product packages. The group coordinates site activities for on-site packaging engineers, and supports most Digital facilities with centrally run cross-plant projects.

Contact this group when you need shipping packages designed. Members will provide written cost and schedule quotes, and help you develop packing procedures. They will also perform the component engineering function in generating purchase specifications for all packing materials.

3.1.3 Hardware Design Assurance

Manager: Paul Rey, (ML11-3/H19, 223-2348)

This group's primary function is to ensure that there exists within Digital the necessary tools, standards, and organizational processes to enable Digital's products to fit into the marketplace relative to hardware oriented regulations, standards, and compatibility.

The group's strategy over the next two years includes driving functions which are necessary for adequate Hardware Design Assurance. These functions are organized within and external to the group depending on the most sensible strategy. The group presently has the nucleus of EMI, International Regulations, and hardware standards. This is a good base to which activities may be added that don't have a home. The group's long-term goal is to have Hardware Design Assurance as part of a Corporate Central Product Assurance group within five years.

Most of the group's activities are being shifted to a pay-as-you-go basis. Some of the services previously provided at no cost will be charged where appropriate. Central funding will be limited to corporate cross-product activities, and seed money to start new activities. All central funding is spent in the group's cost center with the exception of Product Safety funding. This funding is allocated to the Corporate Product Safety group for product safety service to central engineering.

3.1.3.1 Electromagnetic Compatibility

Manager: Pete Boers, (acting) (ML11-3/H19, 223-5452)

This group ensures that Digital's products meet international requirements for electromagnetic compatibility (EMC). To do this, the group monitors EMC regulations and tries to influence them through membership in industrial organizations that deal with EMC. Members develop corporate guidelines and standards to guide corporate strategy in complying with EMC regulations.

The group provides consultation on design problems in the EMC area. They integrate Engineering, Marketing, Manufacturing, and Field Service efforts relative to EMC, and determine what quality assurance programs are needed in manufacturing to guarantee consistent EMC characteristics in Digital's products. Electromagnetic Compatibility testing services are also provided.

3.1.3.2 Electrical Integrity

Manager: Pete Boers (acting) (ML11-3/H19, 223-5452)

The functions of this group apply to decentralized Engineering facilities that can justify local EMC support. Members of this group are local EMC engineers who will expand their scope to cover electrical integrity issues. They participate on hardware design teams, providing design guidance that pertains to electrical integrity.

They devise solutions to problems involving the electrical interaction of system components. They develop test methods for verifying electrical integrity. They also maintain working relationships with Manufacturing's Final Assembly & Test (FA&T) group and Field Service to ensure that Digital's products have electrical integrity. The maintenance of DEC Standard 186, Signal Integrity, is also a function of this group.

3.1.3.3 International Regulations

Manager: Dick Amann, (ML11-3/H19, 223-9837)

The primary function of this group is to ensure that Digital's products comply with general international regulations. The group monitors regulations, developing and guiding corporate strategy for compliance. They coordinate the efforts of Engineering, Manufacturing, Marketing, and Field Service in meeting regulatory requirements.

This group also provides Digital with an overview of international marketing needs relative to product design and testing. They assess risk and return-on-investment results, making recommendations on issues that concern hardware conformance to these marketing requirements.

You may consult with group members to help you identify reasonable goals in your product design. They can also help you with the implementation of DEC Standard 060 (Policy Requiring Certification for Digital Hardware Products to National and International Regulations), for which the group is responsible.

3.1.3.4 Hardware Standards

Manager: Paul Rey, (ML11-3/H19, 223-2348)

This group monitors Digital's market-related hardware standards, providing available product design information to interested groups. They identify market areas that might be adversely affected by a lack of related Digital hardware standards.

They also determine if existing regulations and/or market-related standards need revision. If such is the case, they then ascertain the person or group responsible for the existing or proposed regulation or standard, and obtain a commitment to revise or create the needed information.

3.1.3.5 Product Performance Data Base

Manager: Dick Amann, (ML11-3/H19, 223-9837)

This group is responsible for coordinating the compilation of hardware standards test information for insertion in a common data base management system. They also compile the corporate hardware product regulatory compliance listing. At present, the group is establishing an easily accessible data base for product test information. This data base will be integrated with a higher-order corporate information system for easy roll-up and distribution of summary results.

3.1.4 Power Supply Engineering

Manager: Henk Schalke, (ML8-4/E86, 223-7103)

Power Supply Engineering designs and introduces power supplies, power controllers, regulators, battery back-up modules, and power distribution assemblies into production. The group also reduces costs and enhances products by adopting different product technologies.

Consultation and design techniques for your power systems development, including AC power installation requirements, power distribution systems, and computer systems Uninterruptable Power System (UPS) requirements, are also provided.

Power Supply Engineering also maintains these standards:

DEC Standard 002 – AC Power Wiring, Grounding, Receptacles, Nameplates
DEC Standard 122 – AC Power Lines
DEC Standard 123 – Power Control Bus

Contact this group in the early stages of your project, and during the packaging of your product, at which time trade-offs on technology, packaging concepts and requirements, and partitioning of the power system are implemented.

3.1.5 Industrial Design

Manager: Dick Schneider, (ML11-4/E53, 223-2256)

The Industrial Design group develops and maintains product aesthetic designs that have broad applications. Services of this group encompass related aspects of aesthetics, human factors, product recognition, and product related graphics.

Group Objectives

Aesthetics

- To develop a distinctive and attractive appearance that denotes a high-quality product appropriate to the end-user environment
- To establish and maintain a strong physical resemblance among products throughout the product lines
- To ensure that products for the user are easy to understand
- To ensure that products are convenient, comfortable, and safe to use
- To ensure that the user-product relationship is efficient

Human Factors

- To ensure that products for the user are easy to understand
- To ensure that products are convenient, comfortable and safe to use
- To ensure that the user-product relationship is efficient.

Product Recognition

- To ensure that the basic configuration of a product relates well to other products in structure, materials, finish, and physical and mechanical attributes.

Product Related Graphics

- To design and develop product identification graphics such as logos, labels, nameplates, control graphics, and packaging graphics with attention to the selection and control of color.

Industrial Design can furnish you with human factor analyses. They can also help you develop instructional material for non-technical users. Members of the group generate mock-ups, models, and prototypes. They design artwork, documentation, and specifications for all forms of purchased labels, including class 36 labels.

Contact Industrial Design during the product concept phase. They need enough time to study and understand your needs and to relate your product to other Digital products.

3.1.6 Systems Integrity
Manager: Don Vonada, (ML3-3/E67, 223-2422)

Systems Integrity is concerned with the successful transmission of energy between a source and a destination. Group members represent a corporate technical resource for consultation on systems electrical integrity over a spectrum of media and technologies. They conduct analyses on crosstalk and impedance characterization of printed circuit etch and Unibus/Q-bus cable configurations. The group is also involved with advanced interconnect technologies such as fiber optics and high speed serial data transmission. Finally, the group provides product support for the Unibus, Massbus, and other traditional buses.

3.2 ENGINEERING PLANNING AND ADMINISTRATIVE SERVICES
Manager: Paul Bauer, (ML3-3/B91, 223-6581)

This organization oversees business planning, strategic planning, plant engineering, security, office services, shipping and receiving, telecommunications, and space and facilities planning for Central Engineering.

The organization's business and strategic planning activities are described in the paragraphs that follow.

Business Planning

This group, headed by Jeff Scott, (ML3-3/B91, 223-6743), maintains and develops:

- Product Business Planning Processes
- Product Contracting Processes
- Hardware Product Phase Reviews (not currently defined for Hardware Development)

They operate a Product Planning Data Base created from Product Plan Summaries (PPS). A primary goal of the group is to maintain an orderly means of monitoring product-level planning and development. The group ensures that products are integrated into the overall corporate product space.

Business Planning can supply you with Product Plan Summaries for products in development. A library of such summaries is maintained in the Corporate Library, (ML4-3) as well as in several remote locations.

The group can also furnish you with the Yellow Book that includes status versus plan information for products in development. The Yellow Book is closely coupled to the Business Planning Process.

Business Planning is a participant in and facilitator of the product life cycle approval process.

Your Product Manager is usually the person who deals directly with Business Planning. The Product Manager will need, from time to time, functional dependency, and cost and schedule information to support the business planning of a project.

Strategic Planning

This group, headed by Paul Bauer (acting), (ML3-3/B91, 223-6581), facilitates and administers the strategic and operational processes that lead to publication of the Red Book (Strategic Plan) and Beige Book (Operational Plan).

The Red Book is Engineering's statement of its plans to the Engineering Board of Directors (EBOD). The Beige Book is a set of Engineering internal documents to make sure that the budget and resources to achieve the Red Book objectives are in place.

You may be asked to help develop plans for products as much as five years away. The Red and Beige Books can help you make decisions based on the most complete product information available.

3.3 ENGINEERING INFORMATION

Manager: Dick Reilly, (ML4-4/E99, 223-2982)

Engineering Information has systems and procedures for the creation, control, maintenance, and distribution of part and option information. The organization operates some of these systems and procedures, and monitors most. Groups include Engineering Information Control, Corporate Micrographics, Standards and Methods Information and Control, Unit Charge Administration, and Engineering Computer Services. Engineering Information is also responsible for the functional management of all Engineering Services sites.

3.3.1 Engineering Information Control

Manager: Ray Melanson, (ML4-2/E90, 223-3025)

This group coordinates and expedites the Engineering Module Release Package (as defined in DEC Standard 142) between Design Services sites and Manufacturing Tool Generation. The group acts as a liaison and provides a scheduled van courier service to transport various engineering design-related media, supplies, and release packages to facilitate the Engineering Release Process.

Engineering Information Control also assigns blocks of part numbers and enters and updates part number data on the Master Parts File as requested by various sources (Chief Engineer, Manufacturing Financial Control, Packaged Systems, Field Service, and Design Services). It also aids and supports various Manufacturing stockrooms by generating and updating Manufacturing Bill of Materials upon request.

The group also provides a Central Engineering Archive Control by which all released data is duplicated for off-site archive storage. Archive control is responsible for providing engineering data recalls and controlling and checking retention dates.

The group is additionally responsible for maintaining and automating the Document Control File (DCF). The DCF is an automated file with document number, description, revision, ECO pending, and site location data. A long-term goal is to automate all existing documents (approximately 300,000).

Engineering Information Control receives and processes requests from Design Services groups to transfer engineering data from the Maynard Mill (or another site) to the requesting site. The process includes pulling the original engineering data from the Maynard Library, updating the DCF (Document Control File), processing a pink card microfilming package, and shipping via the group's central services liaison distribution.

Engineering Information Control is responsible for distributing (via TWX) all Maynard Mill ECOs (preliminary and final issue) to an ECO distribution of 58 people.

This group is also responsible for developing, writing, and conducting user training courses related to CAD (Computer Aided Design) systems. Training extends to CALDEC (Computer Aided Layout by DEC), IDEA (Interactive Design Engineering and Automation) systems, SUDS (Stanford University Design System), and PRTLST (Parts List).

They manage all libraries associated with CAD systems that are used by Engineering Services. These libraries include:

Special Features Library	Rennie Ellice (ML3-5/T28, 223-6604)
Physical Shape Library	Tom Witowski (ML3-5/T28, 223-4242)
Assembly Library	Ria Kruijk (ML3-5/T28, 223-4633)
Artwork Step and Repeat Library	Rennie Ellice (ML3-5/T28, 223-6604)
Schematic Symbol Library	Tom Witowski (ML3-5/T28, 223-4242)

Finally, the group is responsible for the issuance, use, and control of Engineering Notebooks. All Digital employees engaged in the design, development, support, or testing of Digital processes or products are responsible for obtaining an authorized Engineering Notebook, from Nat Rounds (ML4-2/E90, 223-9474), keeping it up to date, and returning it to Engineering Information Control. DEC Standard 141 provides more detail on your responsibility regarding Engineering Notebooks.

3.3.2 Corporate Micrographics

Manager: Bob Marshall, (ML4-2/B63, 223-3815)

This group is responsible for the creation of microforms from hard copy or source documents. The documents are filmed, processed, inspected, duplicated, and returned.

The group also performs Computer Output Microfilming (COM) in Merrimack. This technique produces microfilm directly from computer media, by-passing the requirements for drafting on paper. The master film is created, inspected, and duplicated. The finished products, 105 mm microfiche and duplicates, are distributed as requested.

Engineering Graphics, located at ML1-1, and also headed by Bob Marshall, performs document reclamation and enhancement in the forms of mats and wash offs. Mats are blueline, 7 mil. film sheets imprinted with a grid format used for laying out printed circuit boards for the GEMS (a semi-automated process of digitizing printed circuit layout) operation. DEC Standard 013 describes available mats. Wash offs are polyester-based photographic copies of original documents. These are generally full-sized, black line reproductions with matte finishes.

Microfilm Distribution, headed by Irene Fredette, (ML4-2/B63, 223-6745), microfilms new and revised engineering drawings using 35 mm film which is then mounted onto aperture cards. Duplicate diazo aperture cards are produced from silver negative cards and distributed to over 30 Digital facilities to create and update Engineering documentation aperture card files.

To support the maintenance print set business, photographic enlargements made from silver negative aperture cards are available on request.

3.3.3 Standards and Methods Information and Control

Manager: Joe Kurta, (ML5-2/E56, 223-8895)

This group is responsible for the administration and support of DEC Standards, general Engineering information, A-SP-7665xxx specifications, Engineering forms and formats, Engineering procedures and related manuals, certain categories of controlled memos, and over 150 distribution lists.

DEC Standards

DEC Standards are policies, guidelines, specifications, and procedural descriptions that establish company, Engineering, Manufacturing, and technical requirements for items, materials, processes, methods, designs, and organizational practices that are not product specific. DEC Standards are avialable in both hard copy and microfiche.

The purposes of DEC Standards are:

a. to establish procedures for interaction among different organizations (Engineering, Manufacturing, Field Service, Quality Assurance, etc.)

b. to provide realistic solutions to recurring problems

c. to establish common practices, procedures, and methods to ensure compatibility among company organizations

d. to provide the company's interpretation and methods for implementing external or industry standards

e. to increase the quality and profit of company operations by fostering uniformity in product design, symbology, configuration, testing, inspection, transportability, and interchangeability

DEC Standard 001, Section 0 describes the corporate policy for DEC Standards and provides general information about the management and administration of the DEC Standards system. It also defines categories and levels of standards.

DEC Standard 001, Section 1 describes the procedures required to create new standards and make changes to existing ones.

DEC Standard 001, Section 2 describes the format and minimum content requirements for DEC Standards.

You will find a listing of all avialable DEC Standards in the Appendix of this manual. Contact the DEC Standards Administration for more up to date information: 223-2954.

General Engineering Information and Specifications

Standards and Methods Information and Control is a focal point and authoritative source for the preparation and dissemination of general procedures and requirements for Engineering and other areas with which it does business.

Engineering Forms and Formats

In conjunction with Northboro Printing and Circulation Services, the group is the Engineering focal point for updating Engineering forms and introducing new ones. Examples include ECO (Engineering Change Order) and Work Order forms.

The group also works with Purchasing and Engineering Service sites to evaluate outside vendors who are contracted to print and produce specially formatted drafting materials in compliance with DEC Standard 013.

Manuals

The group's technical writing staff writes, edits, and updates manuals required to support Engineering information and communication processes. Such manuals include the Engineer's Orientation Manual, the DCF (Document Control File) User Manual, IDEA (Interactive Design and Engineering Analysis) Training Manual, the Producibility Handbook, the Symbology Manual, and the Engineering Handbook, to be available in 1980.

The Engineering Handbook is actually a set of books to help the engineer get the job done. Expanding the contents of the Engineer's Orientation Manual, the Handbook will contain detailed design, product development, Manufacturing, software, etc., information with emphasis on methods and procedures.

Distribution Lists

Standards and Methods Information and Control also maintains distribution lists essential to the dissemination of Engineering information. Over 150 lists are maintained. Copies of the lists and labels for mailing are available on request at no charge.

The group also ensures that pertinent information for engineers regarding changes to DEC Standards, procedures, and related subjects is made available to the *Engineering Newsletter*. The *Engineering Newsletter* is a vehicle for publishing essential processes and procedures that often cannot be disseminated to the Digital community via distribution lists.

Finally, the group can provide technical writing, editing, and consultation to anyone preparing a document to be under the group's control. If needed, they will expedite and contract outside writing, illustrating, and publishing services. Additionally, the group will provide guidance and prescribed formats to engineers who intend to prepare non-product-specific Engineering documentation.

3.3.4 Unit Charge Administration

Manager: Charlie Picariello (ML4-4/E99, 223-2848)

Unit Charge is a system by which Engineering Information and Service managers may track spending on a specific task within a project. It enables managers to determine what the charge for a service will be before the charge comes through at the monthly financial closing. When a manager receives a bill for unit charge, he or she is able to relate the dollars to the kinds of services performed.

Unit Charge helps service managers become business managers. Using the system, managers may accurately estimate future work load demands and personnel, capital, and inventory requirements.

Unit Charge also has a data base with historical information to assist those who would like to know more about the metrics of the design process. Unit Charge reports are generated weekly to be used as management information tools, not invoices. These reports back up the Corporate Discrete Project Cost Center Reports.

3.3.5 Engineering Computer Services

Manager: Dick Reilly (Acting), (ML4-4/E99, 223-2982)

Engineering Computer Services provides medium and large system data processing support to Digital's engineering organizations in Maynard. They are responsible for managing CAD's Maynard computer-related assets. There are two functional subgroups within Engineering Computer Services: CADnet Operations, and System Software Support.

3.3.5.1 CADnet Operations

Manager: George Vogelsang, (ML1-1/E24, 223-2248)

This group provides CADnet (Computer Aided Design Network) support for engineering organizations in Maynard. Both CAD tools and general time-sharing applications are available. The CAD tools are a specific set of applications that facilitate development of printed circuit boards and LSI chip design. The time-sharing applications are valuable in software and hardware development.

Table 3-1 lists the Engineering computer facilities located at various sites throughout Digital. The contact person at each site can give you access to the equipment. He or she can also give you an account number, tell you how to schedule machine time, how to report a machine malfunction, and how to get it repaired.

Table 3-1 ENGINEERING COMPUTER FACILITIES

SITES	TYPES OF SYSTEMS	PRINCIPLE USE	CONTACT
MR1-1	DECSYSTEM 20s	Marketing Data Center	John Gannett, 231-6456
MR1-2	DECSYSTEM 20s	Software Development	Steve Jablonski, 231-6377
MR1-2	DECsystem 10s	CAD, Software Development	Dick Stevenson, 231-6373
MR1-2	PDP-11s	Communication Networks	Steve Jablonski, 231-6377
ML1-1	DECsystem 10s	CAD	George Vogelsang, 223-2248
ML1-3	DECSYSTEM 20s	Storage Systems Development	Sue Goff, 223-3285
ML4-4	DECsystem 10s	Software Development	Jose Colon, 223-7747
ML4-4	DECSYSTEM 20s	DECnet, Diagnostics	Jose Colon, 223-7747
ML4-4	VAX	SDC Support, DECUS	Jose Colon, 223-7747
ML5-5	PDP-8s	DECnet	Joe Coviello, 223-2876
ML5-5	PDP-11s	Software Development	Joe Coviello, 223-2876
TW	DECsystem 10s	IDEA, SUDS, Time-sharing	John Lyons, 247-2704
TW	PDP-11s, VAX	Software Development	Fred Kilmartin, 247-2455
MK1-1	VAX, PDP-11s	Software Development	Jim Friel, 264-6601
MK1-1	DECsystem 10s	Software Development	Jim Friel, 264-6601
MK1-1	DECSYSTEM 20s	Software Development	Jim Friel, 264-6601
MK1-2	DECsystem 10s	Performance Evaluation	Roger Cady, 264-5045
MK1-2	PDP-11s	Performance Evaluation	Roger Cady, 264-5045

CX	PDP-11s	GEMS, Time-sharing	Wes Brown, 522-3105
CX	PDP-11s	Software Development	Wes Brown, 522-3105
CX	PDP-11s	Software Diagnostics	Wes Brown, 522-3105
CX	DECsystem 10s	CAD, SUDS	Wes Brown, 522-3105
CX	DECSYSTEM 20s	Timesharing	Wes Brown, 522-3105
WZ2	DECsystem 10s	CAD	Art Wessels, 238-2454
RE	DECSYSTEM 20s	Software Development	Frank Jackson, Ext. 205
RE	PDP-11s	Software Development	Frank Jackson, Ext. 205
PK1	DECsystem 10s	EPLS	Bob Murphy, 223-3714

3.3.5.2 Systems Software Support

Manager: Mike Mitchell, (ML1-1/E24, 223-8569)

This group provides software support for the CAD data processing sites. They also support system communication network interfaces, system strategy, and performance metrics.

3.4 ENGINEERING SERVICES

Functional Manager: Dick Reilly, (ML4-4/E99, 223-2982)

Engineering Services' satellites are located at various sites throughout the world. All sites, however, do not presently offer a complete range of services. Engineering Services provides the following functions:

Design Services – drafting, layout of printed circuit (PC) boards, and integrated circuits (ICs), Engineering Change Order (ECO) administration

Document Services – reproduction, library and documentation control

Model Shop Services – stockroom, metal fabrication, prototype assembly, model assembly

3.4.1 Design Services

Site	*Manager*	*Mail Stop/DTN*
(Hudson)	Jim Fleming	ML11-2/E83, 223-2287
Maynard 4-5	Jim McHugh	ML4-5/T38, 223-8892
Maynard 3-6	Dick Cook	ML3-6/E42, 223-2984
Acton	Al Raimondi	AC, 232-2466
Marlboro	Roger Pothier	MR1-2/E74, 231-6710
Merrimack	Joe Madden	MK1-1/B7, 264-6672
Tewksbury	John Wanamaker	TW/D17, 247-2551
Colorado Springs	Mike Elkins	CX, 522-3156
Phoenix	Art Huhtala	PN, 1-(602)-993-5111, X375
Westboro	Ted Kelley	WZ2, 238-2286
Nashua	Ron McCollem	NU, 264-6271
Costa Mesa	Larry Cleghorn	CW, 1-(714)-979-2460
Kanata, Canada	Ted Gillespie	KA, 621-2518
Reading, England	Brian Good	RE, [44]-(374)-58-3535, x239

Site	*Manager*	*Mail Stop/DTN*
Annecy, France	Roger Perret	AE, [33]-(50)-66-23-45
Munich, Germany	Ulrich Nielsen	MU, [49]-(89)-35-031
Stockholm, Sweden	Kaj Nilssen	SO, [46]-(8)-730-0800
Tokyo, Japan	Fujio Kawaguchi	TK, [81]-(3)-341-5481
Sydney, Australia	Bob Starkey	SN, [61]-(2)-428-2866

Design Services works with engineers to provide documentation support and design assistance. The sites listed above will help you generate the documentation necessary for Manufacturing to build your product and Field Service to maintain it. Services available include:

Mechanical Drafting

This service includes the mechanical design of metal fabrication, and all levels of assemblies; members also perform checking and expedite engineering change orders (ECOs).

Manual and Automated Electrical Drafting

For automated, electrical drafting, this service employs SUDS (Stanford University Drawing System) to formalize electrical diagrams, flowcharts, block diagrams, and circuit schematics.

Manual and Automated Printed Circuit and Integrated Circuit Layout

This service includes manual or automatic layout and taping by any of the following three methods:

IDEA – Interactive Design and Engineering Automation – a second-generation automated design developed entirely by Digital

CALDEC – Computer Aided Layout by Digital – an interactive tool providing automatic placement of components, routing of networks, and checking of special wiring rules

GEMS – A semi-automated process of digitizing printed circuit layout

Design Services can help you in other ways, too. Their data services include generation of physical drawing tapes, wire wrap data, and ROM and PROM data entry listings. They can also generate prototype tool tapes, photo artwork tapes, and drill tapes.

Not all Design Services satellites furnish all of the services listed above. Contact Design Services during the planning stage of your project. They will inform you of the kind of help you will need throughout your project's life. You must provide them with funding and schedules, sketches and drawings and, in the case of modules and options, an Engineering Services Work Request approved by the Chief Engineer, Dick Best (ML3-3/H14, 223-2273).

3.4.2 Document Services

Table 3-2 lists the Engineering Document Services facilities located at various sites throughout Digital. All sites create hard copies from microfilm aperture cards (these cards are stored in the Microfilm

Reference Library at the site). Some sites are equipped to create prints and make reduced prints of drawings. Some sites can make copies and reductions of non-transparent originals. Still other sites have their own Site Design Library for indexing, storing, and retrieving original drawings. Contact the site nearest you for services offered in addition to those listed in the table below.

TABLE 3-2 ENGINEERING DOCUMENT SERVICES SITES

LOCATION/ MAIL-STOP	SERVICES AVAILABLE	CONTACT/DTN
ML4-2/E27	D	Carol Fiorentino, 223-3931
ML6C-2/E27	A, B, C	Al Burke, 223-8526
MK1-1/B07	A, B, C, D	John Devin, 264-6671
MR1-2/E74	A, B, C, D	Dave Sireen, 231-6712
TW/D17	A, B, C, D	John Wanamaker, 247-2551
CX	A, B, C, D	Mike Elkins, 522-3156
PN	A, B, C, D	Art Huhtala, 1-(602)-993-5111, x375
AB	A, B,	Rick Gnekow, 1-(505)-345-3311, x2013
NP	A, B, C, D	Tony Chulada, 264-6274
WO	A	Bob McCarthy, 236-2496
WM	A, B, D	Ernie Nourie, 241-4295
BT	A	Joanne Gallant, 266-2243
RE	A, B, C, D	Brian Good, [44]-(374)-58-3555, x2396

Key
A = Creates hard copies from microfilm aperture cards
B = Creates prints of drawings you supply
C = Creates reduced prints of drawings you supply
D = Files original drawings and creates prints of filed drawings

3.4.3 Model Shop Services (Maynard)

Manager: George Gerelds, (ML5-3/E22, 223-2309)

Four groups provide a range of Model Shop services for any one who needs them. The *Stockroom* supplies component parts for your design. The *Mechanical Prototype Shop* fabricates metal, plastic, and wood units. The *Prototype Assembly Shop* assembles prototype modules and subassemblies. The *Production Model Shop* is concerned with model assembly. The specific functions of these groups are outlined in the paragraphs which follow.

Engineering Stockrooms

The various stockrooms stock company-preferred components to avoid the incorporation of obsolete or non-preferred parts into new designs.

Component requirements for a project should be submitted to the appropriate stockroom early enough so that a vendor's delivery schedule will not delay your project. You must supply the stockroom with a parts list showing Digital part numbers (see DEC Standard 012, Section 2, Inventory Class Codes). You must also supply an engineering charge number and fill out a work order form. Stockrooms will purchase components from vendors, and assemble kits in reasonable quantities. A good rule of thumb is to submit your parts lists just before submitting your new design to the Design Services group.

The Maynard Stockroom (#63) stocks components for prototypes and production models. It also expedites components and software supplies from other stockrooms. Stockroom #63 does not expedite LSI (Large Scale Integration) parts.

TABLE 3-3 ENGINEERING STOCKROOMS

LOCATION	NUMBER	CONTACT/DTN
ML5-3	#63	Jim Castano, 223-3774
MR1-2	#13	Sharon Lindsay, 231-6763
TW	#348	Bill McMahon, 247-2869
ML1-3	#132	Sue Goff, 223-3285

Mechanical Prototype Shop Manager: Ed Mayall, (ML1-1/E22, 223-2583)

This group fabricates sheet metal, machined plastic, and wood. It also provides machine shop services such as milling, grinding, lathe work, and heat treatments.

You must supply the group with sketches and/or blueprints. You may give verbal instructions, too, but written instructions are better. Because the prototype process often requires several passes, do not order more prototype units than you need.

Prototype Assembly Shop Manager: Jim Castano, (ML5-3/E22, 223-3083)

This group assembles prototype modules, small sub-assemblies, wire-wrap assemblies, printed circuit boards, cable harnesses, and other equipment. Not limited to providing prototypes, the group provides assistance in small-lot production jobs which cannot be handled cost-effectively in Manufacturing. The group will also do bread-boarding for you, check for errors in documentation, and advise you as to the volume producibility of your prototype.

The group's assembly rates are based on the number of module components and are competitive with outside vendors. You may contact the Prototype Assembly Shop on an informal basis, that is, you may walk in and describe what you want without having to submit formal documentation. Contact the group in the planning stage of your project.

Production Model Shop Manager: Brad Sparkes, (ML5-3/E22, 223-3255)

The Production Model Shop builds printed circuit board models and subassembly models (e.g., power supplies, power controls, cable assemblies) on request for Manufacturing to compare with production units. The group also generates hand testers for low-volume items, or for items that are not tested on automated module test (AMT), computerized module test (CMT), or standard test equipment.

In addition to building models, the Production Model Shop performs odd jobs that range from building wire-wrap boards and cable harnesses to assembling show mock-ups and filling low-volume customer orders. Group members will perform a quality control check on any item upon request. Finally, the Production Model Shop will create and verify a bill of materials (BOM) from an engineer's parts list or from information provided by Design Services.

If you want to use the group's services, you must provide some kind of documentation from which group members can work. Jobs for Digital customers require formal documentation. For other jobs, any documentation will suffice provided it is legible and easy to understand.

When you want ROMs or PROMs blasted, you must supply them, as well as a punched tape or programmed ROM/PROM.

3.5 ENGINEERING SYSTEMS

Manager: Pete Straka, (ML21-3/E87, 223-3189)

3.5.1 Diagnostic Systems

Manager: Glen Johnson, (ML21-3/E89, 223-4080)

This group provides software, methods, and tools in support of the PDP-11 diagnostic development. They work with Engineering programming groups to develop diagnostic strategies and implement methods and tools, off-line and on-line Diagnostic System software, and system exercisers.

The Product Enhancement Group, headed by John Vrobel, (ML21-4/E10, 223-3330), is a service group designed to provide fault-insertion support and the correction/enhancement of traditional Diagnostic Programs. They currently provide diagnostic support for existing PDP-11 and PDP-8 Diagnostics.

Traditional diagnostics may be defined as diagnostic software in the non-development, non-infant mortality stage. The individual Engineering development groups are responsible for software in the development stage. The development stage will end and the traditional diagnostic stage will begin four months after the initial release of the diagnostic product to the field. At that time, the Product Enhancement Group will assume responsibility for the product. They will schedule fault-insertion, and provide maintenance, support, and enhancements to these diagnostics.

The group also serves as a training ground for entry-level diagnostic engineers. From this base, a career path exists to other diagnostic engineering groups.

Diagnostic Release Engineering, headed by Cecilia Cinnamon, (ML21-4/E10, 223-6303), coordinates the release of diagnostic software for all processor families (8's, 10's, 11's, VAX). The group performs the actual release for all PDP-8 and PDP-11 diagnostics. Currently, the actual release for DECsystem-10 (and 20) and VAX diagnostics are located in MR and TW respectively.

The group administers and implements engineering change orders (ECOs) to diagnostics and maintains a history of each diagnostic program. They also coordinate the distribution of problem reports filed by customer services. They publish periodic summaries of these reports to all Engineering programming groups.

3.5.2 VOTE Group
Manager: Dick Beaven, (ML21-3/E87, 223-8681)

This group is developing a fault simulator for release in FY81. VOTE is a concurrent logic fault simulator to be used for test vector and diagnostic program verification. VOTE incorporates the latest techniques for accurate, efficient simulation and was developed by Ernst Ulrich, (ML21-3/E87, 223-5363). For more information, contact either Dick or Ernst.

3.5.3 CAD (Computer Aided Design) Systems
Manager: Luther Abel, (ML3-6/T28, 223-4221)

CAD Systems Engineering provides computer-based tools used in the engineering design process. These tools are used for the physical design of modules and backplanes, and for logic design at all levels. Such tools include:

- Register Transfer Level (RTL) Simulator used in architectural verification and micro-code development
- logic design and entry tools
- printed circuit and gate-array tools
- backplane design tools
- printed circuit design verification tools

The group creates new CAD tools or major enhancements to existing tools. They maintain expertise in many engineering disciplines. Group members are available for consultation on new tools or technological needs. Four groups make up CAD Systems:

CAD Systems Management

This group, headed by Andy Matthews (ML3-5/T28, 223-8489), is responsible for CAD technology management, long-range planning, and the management of development projects.

Layout Applications Development

This group is headed by Will Anderson (ML3-5/T28, 223-2742), and is responsible for printed-circuit and gate-array layout tools, wire-wrap tools, and ROM/PROM/PLA tools.

Data Structures and Interfaces Development

This group is headed by Phil Sweet (ML3-5/T28, 223-8762), and is responsible for working closely with Manufacturing on design verifications.

Engineering and Analytic Tools

This group is headed by Don Yelton (ML3-5/T28, 223-3437), and is responsible for developing engineering analytic software in the areas of higher level simulation and design layout analysis.

CAD Systems Engineering provides service to the entire Engineering community. Their aim is to provide the engineer with the finest, most cost-effective tools available. Engineers may find out more about what CAD tools do by attending the semi-annual CAD Symposium, by reading the bi-monthly CAD newsletter, or by contacting group managers directly.

It is important to recognize that CAD is both a great benefit and a potential limitation to the design process, especially with regard to technology new to Digital. The earlier you contact CAD Systems Engineering in the design phase, the sooner potential limitations can be removed from your project.

3.5.4 CAD Technical Support

Manager: Bill Wehring, (ML3-5/T28, 223-3223)

This is a user-oriented group whose primary responsibility is to ensure the useability and integrity of CAD tools at all Engineering sites. The group aids in the installation of CAD tools, provides consultation regarding the application of tools, coordinates modifications to existing CAD tools, and creates new ones.

The group also conducts acceptance testing on all software and hardware configurations developed by the CAD Tools Development group (or any other source that they have agreed to support), including problem fixes and enhancements to existing systems before release to production.

Finally, the group is responsible for the control, distribution, and archiving of all software related to CAD tools. These include Source Code, Executable Code, user documentation, and programming documentation.

3.5.5 Engineering Analysis and Reporting Systems

Manager: Jeff Haber, (ML12-B/B93, 223-6942)

This support group develops management and financial information systems for Engineering. The goal of this group is to provide tools to assist Engineering organizations in the planning, control, and overall management of their activities.

3.5.6 Product Descriptive Systems

Manager: John Hittell, (ML3-6/H27, 223-2653)

This group develops processes and systems for collecting, identifying, manipulating, disseminating, and archiving descriptive information about parts and documents. They develop and operate product description systems. Advances in documentation technology are also a function of Product Descriptive Systems.

Descriptive information management is a major problem for Digital. There are over 100,000 items carrying Digital part numbers, and over 600,000 controlled documents describing them, with a yearly growth rate for both in excess of ten percent.

3.5.6.1 Descriptive Engineering Information Process

Manager: Mark Olsen, (ML3-6/H27, 223-8781)

This group manages the requirements for and flow of descriptive engineering information. The goal is to make the business of engineering information simpler, faster, and more cost effective.

The group is currently working to define parts and documents and their relationship to each other. This includes defining methods of identifying and controlling changes to parts and documents, how a part and its document are linked, how parts are grouped to form products, and what the documentation needs are for different types of parts. It also includes identifying what information is needed to describe a part and how this information is stored and retrieved.

The group is also working to define the new product life cycle (release/change) process.

3.5.6.2 Engineering Product Library System
Manager: Carolyn Rodriguez, (ML3-6/H27, 223-9087)

The Engineering Product Library Systems (EPLS) is a central source of information about Digital's products. Using a computerized data base, EPLS collects, stores, and retrieves information.

Figure 5-1, EPLS Operations, illustrates how this group manages the flow of information. EPLS collects data from such groups as Engineering Services, Purchase Specifications, and the Office of the Chief Engineer. The data consists of such items as the Master Parts File (MPF), engineering parts lists, option-module lists, DEC Standard price lists, Bills Of Material (BOM), and Mean-Time-Between-Failure (MTBF) rate predictions. The data is then supplied to any group requesting information about Digital's products. Such groups include Engineering, Field Service, Sales, Revenue Accounting, Corporate Planning, Manufacturing, and others.

The operating philosophy of the system is that users are responsible for the validity of the information they supply. Product Descriptive Systems of which EPLS is a part, is responsible for the operation and development of the data processing system used to support the information structure. All user needs are coordinated by Product Descriptive Systems. If you have questions about the contents or use of EPLS, call the EPLS hotline, 223-6430.

3.5.6.3 Engineering Product System
Manager: Dee Stewart, (ML3-6/H27, 223-6109)

This group provides system analyses and design, programming, software support, and consultation to help make product information available throughout Digital. This information is disseminated primarily through the Engineering Product Library System (EPLS), described in paragraph 3.5.6.2.

3.5.6.4 Documentation Systems
Manager: Leroy Smith, (ML3-6/H27, 223-5757)

This group analyzes and develops new systems, and exploits new technologies for the recording, retention, reproduction, and distribution of Engineering documentation. The goal is to make documentation more readable, cheaper to produce, and faithful to actual product revisions.

3.6 SYSTEMS EVALUATION ENGINEERING
Manager: Andy Verostic, (ML3-3/E67, 223-5230)

Systems Evaluation Engineering is concerned with verifying that new products developed for the LSI-11, PDP-11 and VAX-11 families are integratable into the complete range of systems which will be

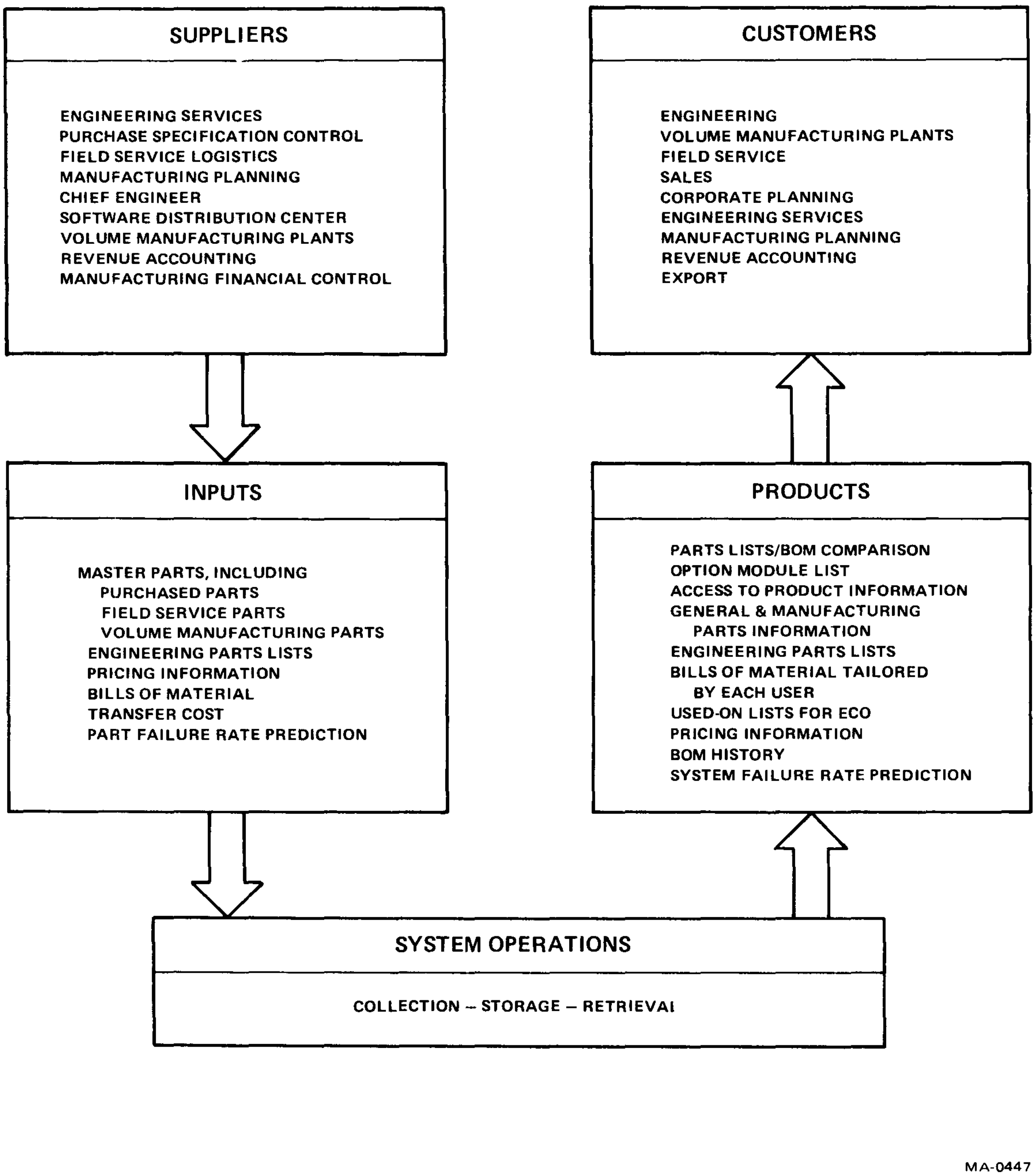

Figure 5-1 EPLS Operations

supported. In particular, the group provides services to development engineering which include the measurement of certain electrical parameters used to define configuration rules, verification of the electrical integrity of device interfaces, and testing of all supporting particulars such as diagnostics, operating systems, and check-out packages across the complete family of systems in which the product will be sold.

The group has available a complete range of Systems, major peripherals, and evaluation tools dedicated to the evaluation process.

Those responsible for new product developments on LSI-11, PDP-11 or VAX-11 Systems should contact the group early in the development cycle to insure proper plans can be developed. Testing normally is conducted on pilot units prior to full Manufacturing start-up.

3.7 OFFICE OF THE CHIEF ENGINEER

Managers: Dick Best, (ML3-3/H14, 223-2273)
Carl Noelcke, (ML3-3/H14, 223-6208)

The Chief Engineer's primary functions are controlling the option module numbering system, processing MTBF (Mean-Time-Between-Failure) data, furnishing specialized or historical data about options and modules, and administering Design Reviews.

Responsibilities of the Chief Engineer, Dick Best

- Assigns model numbers and adds them to the Option Module File in EPLS (Engineering Product Library System) along with a description, what it is used on, product category code, voltage code, status, and responsible people

- Maintains integrity of Option Module File by publishing owners' reports for each responsible person (Engineering Manager, Design Engineer, Product Manager, Field Service Manager, Manufacturing Representative, Major Supplier Stockroom Manager) shown on the Option Module File on a quarterly basis and resolving discrepancies in the data

- Provides data to the Master Part File, Corporate Price File, Manufacturing Hi-Bom File, Product Forecasting System, ECO Control, and Drafting

- Approves Printed Circuit Work Requests

- Approves nomenclature and assigns government code for exporting on DEC Standard Price List Maintenance Forms

- Publishes Option Module List (monthly and quarterly)

- Publishes Engineering Newsletter (monthly) containing technical data and systems and procedures that affect Engineering and Manufacturing personnel

- Provides technical and Engineering consultation

- Member of Engineering Review Board, Engineering Committee, and Patent Committee

Responsibilities of Carl Noelcke

- Administers Design Reviews
  (Each product development project that has been assigned a Discrete Project Number and has a well defined completion point is subject to the Design Review Process)

- Receives Design Review plans from Project Engineer and arranges to have Project Engineer present plan to Engineering Committee for approval

- Acts as Secretary of Engineering Committee
  - arranges agenda
  - writes and distributes minutes
  - signs off DEC Standards

- Maintains Reliability Prediction System

- Represents Engineering on Product Safety Committee

Referenced Material

DEC Standards:

007 - Design Review Process
008 - Project Scheduling System
012 - Unified Numbering Code
139 - Reliability Prediction

4.0 SYSTEMS ARCHITECTURE AND TECHNOLOGY
Manager: Sam Fuller (ML3-5/H33, 223-4562)

4.1 SYSTEMS PERFORMANCE ANALYSIS
Manager: Terry Potter (ML3-3/H24, 223-9749)

This group is responsible for developing performance strategies within Digital. They provide modeling, analysis, and tool development services.

A measurement service collects performance related data on systems and components and analyzes the data based on original study objectives. The analysis service evaluates design alternatives, system sizing, and capacity planning by offering analytical, statistical, and discrete modeling of systems and components. The tool development service develops both general and specific performance data collection and data analysis tools.

These services are used to carry out specific studies as well as to support other performance groups in Digital. Services are available on a charge-back basis to any cost center. Under special arrangements they are available to customers through the Product Lines and Software Services.

4.1.1 Methods and Models
Manager: Linda Wright (ML3-3/H24, 223-7366)

This group provides technical support and analysis primarily to development groups within engineering to help in the concept, design, and development of products. They often analyze the design alternatives proposed by development groups to determine their impact on the systems' performance. They also help to develop methodologies and special techniques for analyzing, measuring, and predicting system performance, and for tuning and sizing current systems.

4.1.2 Performance Tool Development
Manager: Rick Fadden (ML3-3/H24, 223-6483)

The Performance Tool Development group develops both general and specific computer performance data collection and data analysis tools on systems and subsytems.

Contact this group anytime you need to collect or analyze computer performance data but do not have a data collection or data analysis tool available. The group will develop, under contract, the appropriate tool or make an existing tool available.

4.1.3 Measurement and Analysis
Manager: Paul Nelson (ML3-3/H24, 223-3425)

This group provides performance data by conducting performance studies on Digital's systems (hardware and software) and subsystems, and by conducting both analytical and empirical studies of competitors' software, systems, and peripherals. The group maintains a laboratory of competitive gear for examination.

Contact the group anytime measurements are needed on either a software or hardware product. The group will provide a formal, documented report containing the performance analysis requested. The report will include necessary back-up data and methodologies used in conducting the analysis.

To perform work requested, the group needs funding or access to funding for the specific system, peripheral, or software in question. Often the requested information is already available and can be forwarded at no charge.

4.2 STANDARDS
Manager: Pat White (ML12-3/E51, 223-4094)

Standards manages all of Digital's participation in standards committees sponsored by ANSI (American National Standards Institute), IEEE (International Electrical and Electronic Engineering), CODASYL (Conference on Data Systems Languages), ECMA (European Computer Manufacturers Association), and CCITT (International Telecommunications Standards).

The Standards manager defines guidelines for participation and funds travel for Digital representatives. These representatives are chosen from the line organizations by the Standards manager and appropriate development managers. The Standards manager pays the corporate dues to standards organizations.

The group serves as a focal point for information on approved or proposed industry standards. Consultation on the interpretation and implementation of standards is available.

Contact Standards when you are writing the project plan. The group can provide information about all U.S. and international hardware and software standards except safety standards and regulations. (For most internal DEC Standards, contact Standards and Methods Information and Control, ML5-2/E56, 223-2954.)

Also, contact Standards when you need information about Digital's involvement in industry standards committees, when you need help in getting a DEC Standard (software related) reviewed and approved, or when you need to know if a Digital product conforms to ANSI, ISO (International Standards Organization), or FIPS (Federal Information Processing Standards). Contact the group when you want someone to review a Software Product Description (SPD) or Hardware Equipment Specification that describes the product's conformance to industry standards, especially with regard to FIPS. Finally, you might want to contact the group for information on how other Digital products have followed a standard.

Standards can supply you with these documents and services:

- *Standards Reference Pamphlet* – a pocket size list of industry standards by subject; both approved and pending standards are included with codes that indicate status and how to order

- *Standards Summary* – brief abstracts of Digital and industry standards, and probable schedules for all pending standards; gives Digital contact for each standard; does not include standards relating to drafting, micrographics, or corporate processes (refer to Standards and Methods Information and Control for these)

- *Software Standards Notebook* – all approved corporate software-related and software documentation standards; includes description of standards process and complete listing of DEC Standards; distributed by subscription and updated periodically

- *Standards Status Report* – monthly report covering all pending software and industry standards; review dates for DEC and industry standards are included

- *FIPS Conformance Data Sheet* – listing all FIPS and a matrix showing conformance status of DEC operating systems

- *Interests Lists* – lists of people at Digital who are interested and qualified to comment on standards subjects; can be used as a source of names for Design Reviews for related projects

- *Standards Drafts* – drafts of DEC software and industry standards (ANSI, CODASYL, ISO, FIPS)

- *Standards Presentations* – on request the group will make presentations to internal groups and customers on standards issues

- *Consultation Service* – consultation on the interpretation of industry standards or referrals to experts in the company; group will review project plans, Software Product Descriptions (SPDs), and selected functional specifications to identify standards and compatibility issues

- *Standards Writing Help* – help in starting standards projects, professional technical editing, text preparation, printing, and distribution of selected standards

- *Standards Process Documents* – policies and procedures regarding the Software Standards process, format for the same, ECO/Revision control of techncial specifications and proposed DEC Standards, and participation in standards committees (these documents may be found in the Software Development Policies and Procedures Manual)

In order to successfully serve you, Standards needs copies of project plans for all products that would be affected by industry standards. These products include software products, terminals, I/O systems, instructions sets, and diagnostic systems that run under standard operating systems.

Standards also needs to review all Software Product Descriptions and Hardware Equipment Specifications that cite conformance to standards. These documents are legal commitments to conform as defined in the standards.

4.3 VAX-11 AND PDP-11 SYSTEMS ARCHITECTURE

Manager: Bill Strecker (TW/A08, 247-2130)

This group is responsible for the management of key Digital architectures. Management includes the functions of architecture definition, specification, maintenance, and development. The key architectures currently managed include the PDP-11 and the VAX-11 hardware architectures.

The group resolves ambiguities or errors in architecture specifications (e.g., the PDP-11 Processor Handbook, the VAX-11 Architecture Handbook, and the VAX-11 SRM). The group handles requests for changes to existing architectures. Additionally, it assesses the architectural impact of new hardware structures (e.g, bus structures).

Contact the group when you need architecture usage data (instruction statistics) or when you need additional architectures brought under formal architecture management.

4.4 DIRECTOR OF COMPUTER AIDED DESIGN

Manager: Bob Kusik (ML3-5/H33, 223-2320)

As a part of the Office of Technology, this group is responsible for establishing a strategy which will enable Digital to have the best possible CAD capabilities relative to its technologies and products. CAD capabilities include tools (programs), capital equipment, and development, support, and application expertise across the breadth of electrical design and CAM (Computer Aided Manufacturing). A group known as CADBOD (CAD Board of Directors) helps to ensure that the right voices are heard. CAD strategies are published annually in the CAD Redbook.

Because the adequacy of CAD can only be measured relative to technology opportunities and product development requirements, the group welcomes opportunities to interact with technologists and product developers especially during the planning processes of their projects.

4.5 TECHNOLOGY ASSESSMENT AND INTRODUCTION

Manager: Dan Goor (ML12-2/E71, 223-2895)

This group is responsible for assessing externally developed technologies and introducing them to the company when appropriate. They are also charged with comparing Digital's technology with that of its competitors and reporting on it.

The group also publishes a technology newsletter and a yearly "State-of-Technology" Report, a record of the corporation's state of technology and advanced development investments compared to external sources.

Contact the group anytime you require information about external technologies or advanced developments within Digital. They can inform you of new ideas for development and help you promote them within the company. In order to assist you in advanced development proposals, the group needs a clear description of the problem, the proposed solution ("deliverables"), and the required resources to carry out the project.

5.0 LSI (LARGE SCALE INTEGRATION) MANUFACTURING AND ENGINEERING

Manager: Jim Cudmore (ML1-5/E30, 223-2393)

5.1 MICRO PRODUCT DEVELOPMENT

Manager: Joe Zeh (WZ2, 238-2468)

Micro Product Development designs custom LSI circuits that are not available commercially, but are required for use in Digital products. The group should be contacted when you need custom-designed LSI devices and technology, or when you have an idea for an LSI product which could have corporate-wide application.

Micro Product Development is made up of the following groups. Contact the managers listed below for more information in their areas of expertise.

System and Logic Design	- Ken Slater (WZ2, 238-2261)
Semiconductor Circuit Design	- Jack Schneider (WZ2, 238-2355)
Computer Aided Design (CAD)	- Val Patel (WZ2, 238-2456)
Advanced Development	- Don Nelsen (acting) (WZ2, 238-2296)
Technology Applications	- Rony Elia-Shaoul (WZ2, 238-2295)
Computer and Graphics Applications	- Joe Zeh (acting) (WZ2, 238-2468)

5.2 LSI TEST ENGINEERING

Manager: Tom Marmen (WB, 237-2413)

This group is broken down into *class 19*, *class 21*, *memories*, *test process*, and *reliability* groups. The first three groups bring new LSI devices into the corporation. They are responsible for establishing contacts with vendors, generating test programs, qualification, and the overall support of LSI Manufacturing and Engineering.

The *test process* group is responsible for LSI test strategy and new test processes. The *reliability group* is responsible for new reliability techniques and new integrated circuit technology.

Contact the groups responsible for the class of devices you are considering bringing into the company. They can supply you with information on what is available, what is qualified, and what is a problem. The groups need to know what part is being bought and its application.

5.3 LSI PURCHASING

Manager: Dan Hamel (WB, 237-2212)

This group sources all standard LSI as well as custom LSI devices for Digital. It is an awkward fact of life in the 1980's that "standard" LSI devices are sometimes more difficult to source than custom LSI devices due to the increasing cost and time invested by any supplier who elects to copy his or her competitor's largest chips. Design engineers must therefore attend to questions of LSI sources. Sometimes, design engineers must take care to avoid poorly sourced LSI devices (in volume) despite actual in-hand working samples. This must be done to preserve a likelihood that a hot new product with poorly sourced LSI devices will not interrupt a major part of Digital's cash flow. Get help from Purchasing.

5.4 LSI PROGRAM MANAGEMENT
Manager: Peggy Wesley (ML1-4/A97, 223-7854)

Each major Digital custom semiconductor program has assigned to it an LSI Program Manager who serves as a focal point for all activities associated with the design, manufacture, acquisition, and testing of the chip(s). The LSI Program Manager is responsible for working Digital's LSI design and manufacturing resource issues (people, equipment, tools, etc.) based on up-to-date product requirement forecasts.

The LSI Program Manager also gets involved in vendors/resource management as required to meet the program commitments. Communication between the LSI organization and Digital customers (Central Engineering, Product Lines, Volume Manufacturing) is a primary function of the LSI Program Manager.

Early in the product specification phase, the LSI Program Manager can contribute to the development plan by supplying estimated resource requirements for LSI design alternatives. The Program Manager is also available to participate in front-end negotiations with semiconductor vendors on technical and business matters.

Once the product is committed, the LSI Program Manager is actively involved in balancing the forecasted volume requirements with progress being made toward design and manufacturing commitments.

Usually the Product Manager or the Program Manager from Engineering is the person who contacts the LSI Program Manager.

6.0 STORAGE SYSTEMS DEVELOPMENT
Manager: Grant Saviers (ML3-6/E94, 223-9765)

Storage Systems Development is responsible for the development, strategy, and business planning for Digital's storage products. These products include semiconductor and other solid-state memory devices, arrays, subsystems, flexible disks (floppies), cartridge and cassette tape drives, 1/2-inch industry compatible tape drives, and removable and fixed media hard disk drives of all sizes. The organization supplies these products to the corporation by both developing and purchasing them.

In addition to large product development activities in Maynard and Colorado Springs, there are Product Management, Planning, and Advanced Technology groups which support the mission of the organization. Storage products are manufactured in Colorado Springs, Colorado, in Massachusetts (Westfield, Springfield, and Natick) and in Mountain View, California.

6.1 STORAGE SYSTEMS PRODUCT DEVELOPMENT (MAYNARD)
Manager: Bob Jack (ML1-3/E58, 223-6615)

This group is responsible for the design, development, support, and release to Manufacturing of storage devices and subsystem products. These products are used on all systems and sold by all product lines. They include:

- 1/2-inch magnetic tape drives, formatters, and controllers; these include low-cost, low-speed devices as well as expensive high-speed units; examples are the TS-11, TU77, TU78, and TM78

- floppy disk devices, controllers, and systems interfaces; examples are the RX01, RX02, and RX03

- tape cartridge devices, controllers, and systems interfaces; an example is the TU58

- RP07 large fixed disk subsystem (a "buyout" program)

- product support of disk products manufactured at the Springfield, Natick, and Westfield, Massachusetts plants; examples are the RK05, RK06, RK07, RX01, TE16.

This group also works interactively with Systems Engineering groups during the product planning, product design, and testing phases of new product development to ensure that the total DEC System meets its performance and competitive requirements.

6.2 STORAGE SYSTEMS PRODUCT SUPPORT

Manager: Steve Radoff (ML1-3/E58, 223-7601)

Storage Systems Product Support is the engineering design and development group whose main responsibility is to solve technical problems arising from the manufacture, maintenance, and application of disk and tape options.

For engineering problems with maturing disk and tape products currently in production or still in common use, the group serves as the focal point for research, design, and implementation of Engineering Change Orders (ECOs) for tape and disk products manufactured in New England.

The group works closely with Manufacturing/Engineering, Field Service, Product Line Engineering groups, and Product Management.

6.3 MEMORY SYSTEMS ENGINEERING

Manager: Dick Morris (ML21-2/E64, 223-3094)

This group develops most of Digital's electronic storage products. Choosing the optimum device and system technology, the group designs a product, builds its own prototype, and performs Design Maturity Tests (DMT) before releasing the product to Manufacturing, complete with documentation, test tools, and test programs.

The group has the product management function of logistics planning, and provides on-going support to resolve problems and provide cost reductions over the life of the product. They also work closely with Engineering Services, Technical Documentation, Field Service, Systems Evaluation, Diagnostics, and Software Engineering.

Contact the group if your product will need non-rotating storage. Members of the group possess expertise in developing low-cost, high-volume, reliable memory options.

The group needs to know your schedule goals, cost objectives, performance and reliability requirements, and form factor constraints.

6.3.1 Memory Device Engineering
Manager: Dave Dutton (ML21-2/E32, 223-6020)

Memory Device Engineering provides component support for a variety of read/write memory devices including bubble memories, dynamic RAMs (random access memories), and static RAMs. The group collects information about future memory parts, generates purchase specifications, defines incoming inspection tests, and performs device qualifications on current parts.

Contact the group if you are considering using memory devices in your project, if you need help in choosing current or future parts that best fit your requirements, if you need some applications help in designing these parts into your systems, or if you need samples for your prototypes.

Memory Device Engineering can supply you with a spectrum of available memory parts covering a range of cost, performance, density, and reliability objectives. The group can also provide a snap-shot look at future memory devices, availability, price, performance, and reliability. Finally, the group can supply you with a solution to a component or an applications problem.

In order to help you choose the right part, the group needs a list of device requirements, including cost, density, speed, power, reliability, and your expected schedule and quantity needs.

6.4 STORAGE ADVANCED TECHNOLOGY
Manager: Mike Riggle (ML1-3/E58, 223-5316)

The Storage Advanced Technology group is responsible for acquiring a technology base sufficient to allow Digital's storage products to be competitive. The group's efforts, then, are involved in a mix of technology acquisition and development. Advanced Technology generally develops or trades critical, fast-moving technology since it is hard to acquire it otherwise.

The group works with digital and analog circuits, magnetic recording, servos, memory subsystems, large scale integration, mechanical systems, recording and error correcting codes, component development, and solid state memories.

They also provide technology to product development groups working on storage products. Consultation on a variety of storage issues is also available.

The group is composed of two subgroups, Heads and Media and Components Development, and Storage Systems and Memories Advanced Development.

6.4.1 Heads and Media and Components Development
Manager: Bob Rottmayer (ML4-1/B32, 223-3259)

This group designs and develops magnetic recording heads and media. They also develop test equipment for heads, media, and servo writing. In some cases, the group specifies and buys media. The group's expertise lies in solutions to magnetic recording problems. They have specialized equipment, not generally available elsewhere, for the testing and measurement of magnetic materials.

Contact Heads and Media and Components Development whenever you have a problem with either heads or magnetic media in the areas of tapes, floppies, or rigid disks.

6.4.2 Storage Systems and Memories Advanced Development

Manager: George Hitz (ML21-2/E64, 223-3408)

This group works mainly in the areas of advanced development of electronic memory components and systems. They assess current technology, and interact with outside vendors to determine the characteristics of devices. They also conceptualize systems and build prototypes that use such devices as cache memory, main memory, and mass memory.

Contact the group when you need information about advanced memory technology, either for components or for systems. Also, contact the group when a specific memory system is needed. If you supply them with rough parameters (cost, size, etc.), the group can supply you with the technology to develop and design a memory system.

The group has information available about new memory technologies (e.g., bubble memory). They can supply you with a list of vendors, device specifications, availability, price, support functions available, and the like. The group can also supply layout rules, design guidelines, and basic system costs.

6.5 STORAGE SYSTEMS DIAGNOSTICS

Manager: Jim Lacey (ML21-4/E10, 223-3730)

This group designs and develops diagnostics for Digital's disk and tape products. They provide products and services to Engineering, Manufacturing, and Field Service. They also play a key role in the selection of vendor hardware. The group provides consultation and assistance in the early stages of product development to improve product diagnosis.

Storage Systems Diagnostics develops software for Engineering to verify that hardware is in compliance with hardware specifications. They provide software to aid in breadboard and prototype debugging. Additionally, the group provides software to evaluate vendor hardware and to aid in Design Maturity Testing (DMT).

The group also develops software for use in Manufacturing during Process Maturity Testing (PMT), unit production, and Final Assembly & Test (FA&T).

Finally, the group provides software to Field Service to verify complete system installation, to effect a high degree of fault detection and isolation (to speed up the Mean-Time-to-Repair), and to complement other tools in providing preventive maintenance services.

6.5.1 Memory Test Systems

Manager: Tom Lawnsby (ML21-4/E10, 223-2623)

This group develops memory test software. The group is responsible for developing memory component test software, and memory component evaluation software. They also develop life-test software operating systems for array and unit testing.

Memory Test Systems provides Storage Systems Development with all the test software to evaluate its new products. Also, this group provides Memory Manufacturing with software support for all test equipment unique to Memory Manufacturing.

6.6 SMALL DISK ENGINEERING

Manager: Phil Arnold (CX, 522-3170)

Small Disk Engineering develops and supports disk subsystems. The group has developed the RL01 - RL02, and RL11. In addition, the group has engineering support responsibility for the RM02, RM03, the RP05, and RP06. The group is presently engaged in designing new products in the removable media disk drive and low-cost, high-function controller areas.

Contact Small Disk Engineering for technical advice on any of the products listed above.

6.7 MEDIUM AND LARGE DISK DEVELOPMENT

Manager: Demetrios Lignos (CX, 522-3242)

This group is presently working on the R80/RM80 disk drive and the HSC50 intelligent controller. Members within the group work on servos and read/write circuits, and front end interfaces.

Mechanical Engineers work on complex, tight tolerance, mechanical assemblies such as rotary and linear actuators, and spindle assemblies.

Mechanical Packaging Engineers work on the sheet metal packaging of drives with attention to airflow requirements because disk drives are sensitive to temperature variations. These people also define product styling requirements.

Logic designers within the group design the high-performance, sophisticated microprocessor-based control units. System/Software Engineers within the group define the subsystem architecture and write the software code (drives and control unit local microcode) for best performance at the subsystem level and overall system level of operation.

6.8 DIAGNOSTIC ENGINEERING - COLORADO SPRINGS

Manager: Bob Barnes (CX, 522-3200)

This group provides diagnostic engineering for the development and manufacture of storage subsystems. For Engineering, the group provides design assistance and consultation to assure maintainability (RAMP). They design verification software, and breadboard and prototype debug tools. They also aid in Design Maturity Testing (DMT), and assist in vendor selection and evaluation.

For Colorado Manufacturing, the group develops software based on the build requirements in the areas of Process Maturity Testing (PMT), unit production, and Final Assembly and Test (FA&T).

The group also provides the Field Service I/O Diagnostic Group with specification and diagnostic designs required to integrate a subsystem into any of the supported CPU families.

6.9 STORAGE SYSTEMS PRODUCT MANAGEMENT

Manager: Mike Gutman (ML3-6/E94, 223-5285)

This group is responsible for managing all products developed in Storage Systems Development. The group acts as a facilitator of information between technology and marketing, providing a window through which Storage Systems Development may view the marketplace, and Marketing may assess the current technology. The organization is involved in a product from cradle to grave, from conception and development through first-customer-ship and product phase-out.

The group integrates the marketing and development plans of several organizations, develops long-term product strategy, generates and obtains approval of business plans consistent with long-term strategy, and coordinates activities necessary for the successful introduction of sales and service of Storage Systems Development products. It also reviews and analyzes products against corporate profit and market objectives, and continually conducts analyses of the competition.

Products	Product Managers	Mail Stops/DTNs
RP02/03/04/05/06/07 RS03/04 R80, TU77/78	Kevin Smith Paul Feresten	ML3-6/E94, 223-5880 ML3-6/E94, 223-4962
RM02/03/05	John Forde	ML3-6/E94, 223-3516
TU10/16/20/30/40/45/70, TS11	Ken Sills	ML3-6/E94, 223-5805
RL01/02	Wayne Galusha	ML3-6/E94, 223-3221
Floppy Disks	Phil Goldman	ML3-6/E94, 223-5669
DA, RK04/05/06/07, HSC50	John Woelbern	ML3-6/E94, 223-5015
Cartridge Tape TU58	Charlie Moeder	ML1-3/E94, 223-2267
Memory	Pete Durant Celeste LaRock	ML21-2/E64, 223-2147 ML21-2/E64, 223-8897

7.0 DISTRIBUTED AND MID-RANGE SYSTEMS DEVELOPMENT

Manager: Bill Demmer (TW/D19, 247-2111)

This organization is made up of four major groups: Advanced Systems Development, Distributed Systems Development, Mid-Range System Development, and Systems Planning and Product Management. The organization has a common Advanced Systems Development function and a tightly coupled Product Managment group to provide substantial emphasis on the sets of products Digital will require in 3 to 5 years.

7.1 ADVANCED SYSTEMS DEVELOPMENT

Manager: Jim Marshall (TW/A03, 247-2201)

This group works on new product development projects, having expertise in such disciplines as semiconductors, physical interconnect, CAD (computer aided design), communications, and fiber optics. The group is engaged in such activities as putting portions of VMS (Virtual Memory System) into firmware, investigating integrated-bounded systems, and determining hardware/software relationships in distributed systems.

7.1.1 Advanced Mid-Range Systems
Manager: Wayne Rosing (TW/B02, 247-2322)

This group develops new technologies for Mid-Range Systems. The group's focus is on developing technologies for semi-conductors, CAD tools, power and packaging, cooling, printed circuit board interconnect and connector requirements, system architecture, and microprogramming tools. The group also participates in long-range technical planning and top-level system engineering.

Contact the group if you are interested in any of the projects listed above. The group can supply you with technology skills, consultation, simulation data, and general help.

7.1.2 Current Product Engineering
Manager: Mike Powell (TW/C02, 247-2856)

This group provides engineering support for Distributed and Mid-Range Systems products currently in production. These products include the PDP-11 and VAX-11 families of CPUs. Support is also provided for older CPUs marketed by the Traditional Products Group.

The group becomes involved with a new product before its release to Manufacturing by the new product development team. During the first months of volume manufacturing the group assumes increasing responsibility. The transition into Current Product Engineering is complete after several months of production.

The group handles ECOs for safety requirements, adherence to specifications, cost reductions, product enhancements, and documentation. It also provides world-wide support for volume manufacturing, Systems Manufacturing, and Field Service.

The group also provides product support information to Marketing and Sales.

7.1.3 Packaged Systems Engineering
Manager: John Dennis (ML3-4/E81, 223-8467)

This group designs and documents corporate packaged systems. Members evaluate new products developed for the LSI-11, PDP-11, and VAX-11 families to guarantee systems compatibility. They also provide mechanical systems engineering support for the packaging of systems. Additionally, the group assists Systems Manufacturing by resolving systems problems and defining better systems products.

Contact Packaged Systems Engineering as early as possible in the new product design cycle to ensure that your product will be compatible with other Digital products.

7.2 DISTRIBUTED SYSTEMS
Manager: George Plowman (ML5-5/E97, 223-3329)

This organization is responsible for the architecture, development, and implementation of all DECnet products for all families of computers. Distributed Systems has four areas of communications technology for which it is responsible: Internal and External Software/Firmware Interconnect Development, Communications Hardware Subsystems and Devices, Hardware Interconnect Development, and Distributed Applications and Processing. The organization is made up of eight major groups.

7.2.1 DEC Interconnect

Manager: Mary Breslin (ML5-5/E97, 223-7535)

This group is responsible for the development of any product implementing Distributed Network Architecture (DNA), including X.25. The group develops funding and product implementation strategies. These strategies are aligned with the overall long-term strategy for all software DECnet products.

The group is basically engaged in product development, product support and maintenance, program support, and advanced development.

Contact the group if you have questions concerning DECnet certification, network test systems, DECnet performance criteria, and performance measurements. The group supports the DECnet-11M/S, DECnet-11M+, DECnet-RT, 3271/IAS, 3271/M, 2780/3780/RT-11, and the 2780/3780/VMS.

7.2.2 IBM Interconnect and Distributed Applications

Manager: Don Alusic (MK1-1/N34, 264-5187)

IBM Interconnect is responsible for the definition, development, testing, release, maintenance, and advanced development of products that interconnect between Digital's systems and IBM's systems. The group has responsibility for these interconnections on the PDT series, PDP-11 series, and VAX-11 series. This includes BISYNC as well as SNA interconnect products.

The Distributed Applications program deals with applications that work in a distributed or network environment. The development of such applications results in standard products. The group also seeks to better understand the distributed applications needs of customers. To date, most of the group's work has been in the area of electronic mail systems.

7.2.3 Hardware Interconnect

Manager: Dave Rodgers (TW/C04, 247-2369)

This group is responsible for the architecture, and first implementation and validation of hardware interconnect devices (formerly known as bus interconnects). Specifically excluded from the group's focus are internal memory to processor interconnects, and the UNIBUS and Q-bus. All other hardware interconnect devices are included.

Questions concerning the interconnection of DEC hardware should be directed to this group. Specifications and other information germane to hardware interconnection can be provided.

7.2.4 Communications Engineering

Manager: Roy Clites (MK1-1/M37, 264-5811)

This group develops corporate hardware communications products. It also supports over 20 communications products which are sold to OEMs and end-users. The group provides communications requirements, specifications, and data sheets on communications products. Contact the group when you have technical questions on data communications and communications systems. They have extensive knowledge of Digital and non-Digital modems.

7.2.5 Distributed Systems Architecture

Manager: Tony Lauck (ML5-5/E97, 223-6120)

This group is organized to provide a technical focus for the distributed systems program, to define the overall Digital Network Architecture (DNA), and to define and maintain the specifications of key interfaces and protocols which make up the architecture.

If you are developing a hardware or software product that is to communicate as a component of a distributed system, contact this group to receive assistance in understanding or interpreting a DNA interface or protocol. The group can also help you resolve incompatibilities between products which are supposed to adhere to the architecture. The group can also modify the architecture to satisfy the needs of new product development.

In addition to developing and maintaining specifications, Distributed Systems Architecture provides consulting services and operates the DECnet Review Group (DRG), a forum for product implementors to review and approve architectural specifications.

7.2.6 DEC 10/20 Networks

Manager: Tomas Lofgren (MR1-2/E89, 231-5170)

This group develops communication and network software for DEC 10/20 systems. Specifically, this includes DECnet 10/20, DECnet 10, ANF-10, IBM Communication on the DEC-10/20, and the KL10 console front-end software: RSX-20F.

Contact the group if you have a specific interest in any of the products mentioned above. Also, the group has extensive experience in data communications on larger computers. The group has done much work on front-ends.

7.2.7 Distributed Processing Program

Manager: Peter Christy (ML12-3/A62, 223-6110)

The Distributed Processing Program is responsible for developing the corporate distributed processing product and technical architecture objectives. The Program ensures the coordination of relevant plans for Engineering, Marketing, Sales, and Software Services.

The Program is concerned with all products that use multiple, interconnected computer systems (distributed processing). Specific product areas of interest include: networks, communications, interconnect, distributed data management, high availability multi-processor systems, electronic mail applications, and interconnected transaction processing systems.

Projects involved with software destined to run in a distributed processing environment should establish contact with the Distributed Processing Program. The Program will ensure that development groups are aware of work that is planned and in progress. It will communicate the technology and product strategy to the product developers. Furthermore, the Program will ensure that all related work is integrated into a comprehensive plan for distributed processing product development.

7.2.8 Distributed Systems Product Management

Manager: George Plowman (acting) (ML5-5/E97, 223-3329)

This group is responsible for the overall business management of Distributed Systems products. The group's three major areas of focus are long-range planning, sales support, and product management.

The group defines long-term development strategies, and prepares programs for inclusion in the Red Book. They also develop business plans for major aspects of the program. Furthermore, the group coordinates the program budgets and continually conducts analyses of the competition.

For sales support, the group coordinates product promotion, working with Software Services, Field Service, and Educational Services. The group also coordinates sales training, presentations, and product support.

As a product management group, they coordinate and facilitate all aspects of delivering Distributed Systems products to the marketplace. They manage the product business plans, product requirements, the phase review process, and provide product support for Field Service and the product lines.

7.3 MID-RANGE SYSTEM DEVELOPMENT (HARDWARE)

Manager: Brian Croxon (TW/C04, 247-2416)

This organization is responsible for the complete product development of systems, and enhancements to systems, that fall in the mid-range. In the PDP-11 space this includes all PDP-11s from the 11/34 up to the 11/74. This includes all future developments with similar cost and performance metrics in the VAX family.

Generally, the organization implements the Central Engineering product strategy in the mid-range, from initial product development to the complete release of the product to Manufacturing.

Mid-Range System Development is made up of three specific development groups and a diagnostic engineering group.

7.3.1 Mid-Range VAX Development

Manager: Steve Rothman (TW/D06, 247-2290)

This group creates the CPU logic design for the mid-range VAX system. They are also responsible for making sure all other pieces necessary for a complete system are done, including memory, power supply, mechanical design, etc.

Contact the group if you are working on a product that could be attached to the system. The group can supply you with knowledge and expertise on how a product should be designed to build a reliable, integrated system.

7.3.2 Low-End VAX and Small 11 Engineering

Manager: John Sofio (TW/D02, 247-2179)

This group is responsible for the design and development of new CPU systems in the product space named. New programs in product development begin in the Mid-Range Systems Advanced Development group. At some specified point (usually at the completion of a conceptual definition and a detailed project plan) program responsibility and some of the kernel project team come into the group to design, test, and release the new product to Manufacturing.

Contact the group when information about their products is required. The group should be involved in evaluating new products (e.g., peripherals) which fit naturally into the mid-range family. The group has expertise in UNIBUS systems hardware and can be called upon when a sophisticated level of technical support is required.

7.3.3 Large VAX and Large 11 Engineering
Manager: Pauline Nist (TW/CO4, 247-2123)

This group is responsible for the development of the VAX-11/780, the 11/74MP, and any enhancements to these products, such as the MA780 memory.

Contact the group when you are trying to add new hardware or peripherals to large VAXs or large 11s, when you have a VAX-11/780 support problem, or when you need specific hardware implementation or architecture information on large VAXs or large 11s.

If you provide the group with descriptions of hardware engineering issues or existing support problems, they can supply you with information about specific hardware implementations on large 11/70s and VAXs. They can also supply you with information about the status and function of hardware products currently under development, and information about the VAX-11/780 implementation of VAX architecture. Finally, the group can give you an estimate of the work involved to add on any peripherals in the large VAX and large 11 family.

7.3.4 Mid-Range Systems Diagnostic Engineering
Manager: Frank Bernaby (TW/F17, 247-2212)

This group provides diagnostic support for all VAX and UNIBUS-11 products and VAX non-magnetic I/O Subsystem products. Diagnostic support encompasses diagnostic requirements for Engineering, Manufacturing, and Field Service.

The VAX Diagnostic strategy is based on the premise that the VAX project will encompass a family of CPUs implemented over a period of years, eventually overlapping the price/functionality range presently occupied by the 16-bit UNIBUS-11 family. A goal of the group is to achieve consistently effective and consistently functional diagnostic implementation across the VAX family, while also maximizing inter-family diagnostic transportability. Through family orientation, the group supports a strong system-directed effort resulting in test structure/partitioning, packaging, and release control.

7.4 SYSTEMS PLANNING AND PRODUCT MANAGEMENT
Manager: Bernie Lacroute (TW/A08, 247-2113)

This group is responsible for supporting individual systems and products in the product management role. It integrates the overall system planning necessary to achieve a coherent Distributed and Mid-Range Systems product strategy.

The group acts as a facilitator of information transfer between technology groups and marketing, providing a window through which Distributed and Mid-Range Systems may view the marketplace, and Marketing may assess the current technology.

Systems Planning and Product Management integrates the marketing and development plans of several organizations, develops long-term product strategy, generates and obtains approval of business plans consistent with the strategy, and coordinates activities necessary for the successful introduction of sales and service of the development group's products. It also reviews and analyzes products against corporate profit and market objectives, and continually conducts analyses of the competition.

Contact the product managers listed below for more information:

High-end Systems - Peter Conklin (TW/A08, 247-2119)

Medium Systems	- Bernie Lacroute (TW/A08, 247-2113)
High Availability Systems	- Ed Slaughter (TW/A08, 247-2724)
Package Systems	- Walt Colby (TW/A08, 247-2889) Ed Wargo (TW/A08, 247-2120)

8.0 LARGE SYSTEMS PRODUCT DEVELOPMENT
Manager: Ulf Fagerquist (MR1-2/E78, 231-6408)

The primary goal of the Large Systems Product Development organization is to develop and implement the high-end portion of the corporate product strategy for VAX architecture-based systems and all DECSYSTEM 10/20 products.

The organization is made up of five major groups: Large VAX Systems Technology and Advanced Development, DECSYSTEM 10/20 Development and Peripheral Integration, Product Management and Strategic Planning, Operations Programs, and Marlboro Site Engineering, a group responsible for Large Systems Diagnostics, Information Services, Computer Services, and Engineering Services.

8.1 LARGE VAX SYSTEMS TECHNOLOGY AND ADVANCED DEVELOPMENT
Manager: George Hoff (MR1-2/E47, 231-6524)

This group is responsible for 32-bit System Programs and technology development for the VAX Program.

8.1.1 Large VAX Engineering
Manager: Sas Durvasula (MR1-2/E47, 231-4426)

This project group is currently developing VAX-11 processor units to be marketed in the $100k - $250k price range. The group includes senior engineers with experience in these technical disciplines: VAX architecture, high performance CPU design, floating point/array processor design, console design, cache/memory subsystem design, and microprogramming.

The group makes extensive use of SUDS (Stanford University Design System), IDEA (Interactive Design and Engineering Analysis), SAGE (Simulation of Asychronous Gate Elements), microcode simulation, and systems performance evaluation tools. The group is involved in the application of sub nano second technology and high-density components (LSI) to achieve high-performance processor structures.

Contact the group if you wish to investigate advanced implementations of the VAX-11 architecture, the application of high-performance technology to CPU structures, and advanced approaches in applying RAMP (Reliability and Maintainability Program) techniques to improve system availability. Although the group is focused on a specific project and not available to assume additional development tasks, they will provide consultation and assistance to any group requiring their expertise.

8.1.2 Technology and Advanced Development
Manager: Sultan Zia (MR1-2/E47, 231-6277)

This group provides engineering resources to assist in technology development for Large Systems products, both in the VAX-11 series and the DECSYSTEM 10/20 series. The group includes senior engineers experienced in these areas: ECL (Emitter Coupled Logic) technology (10k and 100k), high-density gate arrays, complex multi-layer modules, circuit simulation (propagation delay and noise margin), LSI packaging and cooling, system level packaging, clock design and distribution, UL/CSA/VDE compliance requirements for large systems, computer-aided-design (SUDS, SAGE, Mincut), and power distribution.

Contact the group for information about high-performance technology. The group has extensive experience based on the development of KL10-based systems and KS10-based systems. As a functional group, they are chartered to provide support to development groups throughout Digital, resources permitting.

8.2 DECSYSTEM 10/20 DEVELOPMENT AND PERIPHERAL INTEGRATION

Manager: Bill McBride (MR1-2/E85, 231-6906)

This group is responsible for all 36-bit system programs, current products, and Large System peripheral integration. They are made up of five major groups: New Product Engineering, New Product Programs, Peripherals, Current Product Engineering, and Advanced Development.

8.2.1 New Product Engineering

Manager: Nat Kerllenevich (MR1-2/E85, 231-6440)

New Product Engineering for DECSYSTEMS 10/20 is concerned with all the engineering aspects of DECSYSTEMS 10/20 development. These include logic design and implementation, mechanical implementation, packaging, and power supply.

The group's goal is to satisfy the product requirements of performance, cost, and time-to-market. To meet this goal, they use available technologies and aids, and when required, the group sponsors the development of new methods and techniques (e.g., multiwire, CAD tools, simulations, etc.).

Contact the group if you need to make a physical interconnection to a DECSYSTEM 10/20 under development, or if you have an interest in performance specification issues relating to the group's products.

8.2.2 New Product Programs

Manager: Don Lewine (MR1-2/E85, 231-6430)

New Product Programs is concerned with the construction of new systems for the DECsystem-10 and DECSYSTEM-20 families of computers. The group is responsible for the coordination of all new component projects in a new system. Additionally, they are responsible for the smooth release of a new system into Digital's families of products.

This requires the coordination of the following Engineering groups: hardware logic design, Mechanical Engineering, circuit engineering, and Diagnostic Engineering. It also requires the coordination of TOPS-10 and TOPS-20 Software Engineering, hardware and software documentation, and course development, Marketing, and Engineering Services.

Any group with products, issues, or concerns affecting or affected by large computers should contact this group.

8.2.3 Peripherals

Manager: Roger Lawson (MR1-2/E18, 231-6522)

This group designs and develops I/O controllers and adapters for Large Systems. Additionally, the group is responsible for the integration of all peripheral devices for Large Systems. Controller and adapter development involves the specification and implementation of the I/O system requirements, the release of designs to Manufacturing, and the maintenance of products in the field during early shipments to customers.

Tasks within development include design, prototype building and debugging, coordination of Software's and Diagnostic's efforts, subsystem testing, and the generation and release of engineering documentation. Peripherals integration includes all of the above tasks except design.

The group is divided into two functions: Storage Systems (John Bloem, MR1-2/E18, 231-6209), and Communications/Unit Record (Paul Kelley, MR1-2/E18, 231-6401).

Contact the group whenever you have questions, problems, or suggestions about Large Systems I/O adapters or peripherals.

8.2.4 Current Product Engineering

Manager: Ron Setera (MR1-2/E18, 223-6213)

Current Product Engineering has three major functions: product support, product enhancement, and product qualification.

Product support was formed for the Large Systems' vast array of CPUs, I/O devices, and memories in the field. In this function, engineers provide expertise for solving design problems that were not discovered during the product's qualification and release phase. Product support includes resolving all problems in the areas of product documentation, hardware changes because of non-conformance to specifications, and safety-related changes according to international regulations.

Full product support lasts until the product is turned over to the responsible Manufacturing Engineering group. The product support function of Current Product Engineering will, however, continue to provide technical consultation and be responsible for safety-related changes.

Product enhancement involves designing new functions for current system products. Such enhancements include new instructions added to a CPU through microcode development, or the integration of a new I/O controller or adapter into the system. Product enhancement also tests new system configurations that Marketing groups would like to offer. All necessary testing, documenting, and releasing performed for a system development project are also done for product enhancements.

The group also performs a *product qualification* function. Engineers plan and schedule product qualification by performing an array of tests. They ensure that the product meets the product design specification, that it meets both internal and international standards, and that it completes Design Maturity and Process Maturity Testing. The product must also complete system parameter tests. In this assignment, the engineer learns the system in detail, and becomes familiar with the diagnostics, the operating system, documentation, and the hardware. Upon completion of all qualification tests, the engineer is equipped to support the product in the current product support function of the group.

8.2.5 DECSYSTEM 10/20 Advanced Development
Manager: Ron Melanson (MR1-2/E85, 231-6419)

This group will provide the necessary CAD (Computer-Aided-Design) tools for the design of next generation DECSYSTEM 10s and 20s. These tools will be used predominantly for integrated circuit design, specifically for bipolar technologies. One of the group's goals is to implement a hierarchical version of SUDS (Stanford University Drawing System), necessary for the support of VLSI chip design. Additionally, the group's work in the area of SUDS will encompass upgrading the SUDS graphic I/O to support the newly proposed Siggraph-ACM CORE graphics protocol.

8.3 MARLBORO SITE ENGINEERING
Manager: Roy Ryzak (MR1-2/E78, 231-4140)

The Marlboro Site Engineering group includes development and support functions that support both the Large Systems Engineering organization and the Marlboro product line/marketing groups. In addition, Marlboro Site Engineering is available to provide support to other groups.

Marlboro Site Engineering is made up of these groups: Diagnostic Engineering, Engineering Services, and Computer Operations (see Section 5, paragraph 3.4 for information about Engineering Services).

8.3.1 Large Systems Diagnostic Engineering
Manager: Dick Maliska (MR1-2/E68, 231-6505)

This group develops diagnostic software, console microcode, and other programs to support a wide range of products including products from the Digital Components Group, Laboratory Data Products, Medical Data Products, Federal Systems Group, and the Large Systems (32- and 36-bit) Group. The group has senior diagnostic programmers with experience in these disciplines: CPU micro diagnostics, diagnostic monitors, console microcode, CPU functional tests, and systems exercisors. The group is also experienced in the development of on-line and off-line diagnostic programs for storage systems units, tape systems, unit record equipment, and communication subsystems.

The group has substantial experience in cross-group projects. They should be considered a valuable resource to support projects for any group that requires their expertise. The group has extensive experience supporting KL10-based systems and KS10-based systems, and should be consulted by those pursuing information or diagnostic development for high-performance systems.

8.3.2 Marlboro Computer Services
Manager: Tim Beers (MR1-2/E69, 231-6225)

This group is responsible for providing general timesharing support. They have established data centers to support Software Engineering, Hardware Engineering, Marketing, and CAD processing (SUDS and IDEA). DECsystem-10s and DECSYSTEM-20s are available for use. VAX-11 timesharing is planned for the end of fiscal year 1980.

8.4 OPERATIONS PROGRAMS
Manager: Len Kreidermacher (MR1-2/F18, 231-6617)

Digital develops individual products which must be integrated into a system. The system level integration assignment is performed by a Program Manager. The integration is a called a Program. This group ensures that all products under development within Large Systems Engineering are part of a system and included within one or more of the programs.

The group works to ensure that development groups use the tools available to them during the product development process. Examples of these tools are: Product Business Plan Standard (DEC Standard 130), Software Product Phase Review Procedure (Software Development Policies and Procedures Manual, 5D2-1.A), and BURP (Business Review Program). The use of these tools varies depending on the interpretation of the tool by the user. This group coordinates the interpretation of these tools within Large Systems Engineering to ensure a high-quality and consistent development process.

8.5 PRODUCT MANAGEMENT AND STRATEGIC PLANNING

Manager: Per Hjerppe (MR1-2/E78, 231-6121)

This group formulates short and long-term product planning strategies for all 36-bit systems and large ($100k - $250k) 32-bit systems. The group negotiates and allocates funds to development groups. They translate market needs into requirements for specific systems to be designed by Engineering. They also participate in the phase review of each product's life cycle, from product inception through development, active market life, and retirement.

The group markets products to Digital's product line groups who then market the products to customers. The group also participates in product announcement and promotion, formulating product pricing and policy.

Contact the group for information regarding product strategy, funding, new functions and features of products, and product policy and pricing.

Product managers for Large Systems Product Development are listed below.

Large Vax Systems	Carl Gibson (MR1-2/E78, 231-6779)
Strategic Planning	Maria Tseng (MR1-2/E78, 231-6412)
New DEC 10/20 Systems	Per Hjerppe (MR1-2/E78, 231-6121)
Product Marketing	Leslie Hruby (MR1-2/E78, 231-6424)

9.0 CORPORATE RESEARCH GROUP

Manager: Jim Bell (ML3-2/E41, 223-2764)

The Corporate Research Group provides research, advanced development, information services, consulting, technical education, and technical staff services to the corporation, with particular emphasis on meeting the needs of Central Engineering.

Research

The group conducts an internal research program and also works with external researchers. The research activities consist of five major programs, each of which is composed of several projects. The five programs are:

- Languages, Data Bases, and Applications
- Small Systems and Terminals
- Distributed Processing

- Office Information Systems
- Computer Systems Architecture

Research is the group's largest activity. The *Research Group Annual Report*, *Research Group Strategy*, *Research Group Plan for Current Fiscal Year*, and *Research Project Procedures* are documents that contain information on what the organization is doing and how it is doing it. These publications are available to you on request.

The Research Group writes a monthly report which includes project status reports on every active research project. This report is also available to you on request, in your choice of two levels of detail. Every project has a plan. Periodic technical reports are issued for each project. Most projects have special interest lists for those who would like to receive memos and more detailed material on the topic. The best way to learn more about a project is to contact the Project Leader directly. A tabular summary of all projects, their status, and their project leaders appears monthly in the Engineering Yellow Book.

Project Leaders are anxious to consider research project suggestions from all within the company – let them hear from you.

Advanced Development

This activity complements both R&D's own research and the Advanced Development activities that are distributed among many other engineering groups.

Information Services (Corporate Library)

The Corporate Library, managed by Ralph Coffman (ML4-3/A20, 223-6465), is headquartered in the Maynard Mill (4-3) and is an information center for business and technical information. Its services are available to all Digital employees either remotely or through local branches (see index).

The Corporate Library provides reference books, periodicals, research reports, standards, Digital and competitors' documentation, audio and visual cassettes, inter-library loans, and SCAN searches (a service that finds out what has been written on specific job-related topics). Its Purchasing Department handles individual and departmental purchases of books, subscriptions, memberships, and competitive materials.

For more information, refer to the CORPORATE LIBRARY SERVICES brochure available upon request. For general inquiries, call 223-6231.

Consultation

The Research Group provides consultation on a wide variety of technical subjects, utilizing both internal and external resources. Contact Bob Swarz (ML3-2/E41, 223-2134).

Education

The Research Group serves as the primary technical link with universities. They solicit and fund research proposals from universities in cooperative research investigations for the benefit of Engineering. Additionally, joint research efforts with industrial and non-profit organizations are developed. For more information, contact Dick Eckhouse, University Relations Manager (ML3-2/E41, 223-8706).

The Research Group is also willing to provide technical speakers on a broad range of topics, including current research projects. For a list of topics and speakers, contact Mary Jane Molloy (ML3-2/E41, 223-7687).

The group also coordinates a monthly Engineering Seminar Series. Contact John Morse (ML3-2/E41, 223-5801) for more information.

Technical Staff Services

Research provides technical staff functions designated by the Vice President of Engineering, with emphasis on those services which are future oriented, are leveraged by a broad payoff, or serve to bind together the activities of diverse groups.

Current Research Activities

The five current research programs are described in the sections that follow.

9.1 LANGUAGES, DATA BASES, AND APPLICATIONS
Manager: George Poonen (ML3-2/E41, 223-3537)

This group is conducting research in languages, data bases, and applications. They believe that applications software is going to play an important role in Digital's future. For this reason, the group's goal is to develop expertise and provide tools in this field. Currently, the group's projects are divided into four areas:

- Software Methodology (SEER-software maintenance tool; MPG-business application tool)
- Languages (PL/I, ADA)
- Data Bases (Relational Model, Natural Languages)
- Applications (Computer Aided Instruction-research sponsored by Educational Services; Knowledge Based Systems)

The group's current strengths are in the areas of languages and data bases. They would be happy to provide consultation, tutorials, or other forms of assistance in the above areas.

9.2 APPLIED RESEARCH AND DEVELOPMENT
Manager: Bob Glorioso (ML3-2/E41, 223-5250)

This group's primary interests are in low-end systems and new physical technologies. The group has multi-project programs in Micro-Architecture and in Terminals, and additional projects in Multi-Micro Systems, Human Factors (hardware and software) and Low-End Software. Many applied R&D programs and projects are closely tied to activities in development.

The Applied Research and Development group provides consultation in human factors, and is responsible for tracking microprocessor and associated LSI activities in the semi-conductor industry.

9.3 COMPUTER SYSTEMS RESEARCH
Manager: Rick Peebles (ML3-2/E41, 223-8817)

This group conducts research and advanced development projects in the structure and implementation of computer systems. The group's current focus is on distributed processing and communications. They explore new software technology and attempt to transfer this technology to development groups.

Typically, the group works on projects three to ten years before the product is shipped. The group likes to work on advanced development problems that are a little too far out in time or too risky to be taken on by a development group. They stay abreast of current technology and research activity outside of Digital.

Computer Systems Research can supply you with consultation, prototypes, and analyses. To do their work, they need a clear problem statement and a commitment to continued interaction. One of the group's most difficult problems is managing the transfer of technology and keeping research/advanced development relevant to developers.

9.4 OFFICE INFORMATION SYSTEMS RESEARCH

Manager: Bob Swarz (ML3-2/E41, 223-2134)
Program Leader: Ken King (ML3-2/E41, 223-3066)

This group ensures that Digital has the ability to design products required by the office information systems market. The group assesses products and technologies that appear to be successful in the market. These are then compared to the company's existing products and technologies to determine what products and technologies must be developed to enable Digital to remain competitive.

Office Information Systems Research also sponsors advanced development projects for products that are essential in this market but are missing from the company's present offerings. For example, speech input and output are current study topics. The group also monitors basic research in relevant technologies and applications currently being developed in universities and other places to which they have access.

The group encourages the development or evolution of products oriented toward office information systems. In the short term, the group watches for opportunities to spin off commercially viable products from its advanced development efforts.

9.5 COMPUTER SYSTEMS ARCHITECTURE RESEARCH

Manager: Bob Swarz (ML3-2/E41, 223-2134)
Program Leader: Lloyd Dickman (ML3-2/E41, 223-6159)

The basic objective of this group is to provide insight and direction for the development of computer systems, with emphasis on establishing appropriately architected interfaces.

The Architecture Research Program provides support for development groups throughout Digital. The group investigates evolving architectural issues, collects data describing the behaviour of existing computer systems, and develops criteria for making architectural decisions.

The major beneficiary of the program is the development organization. Working with implementors and product management, the program contributes to product innovation and new product development by providing insights into the behaviour of existing products as well as exploring the implications of applying technologies.

10.0 EXTERNAL RESOURCES

Manager: Henry Crouse (ML1-5/B98, 223-2610)

External Resources is the corporate-wide organization that handles all of the purchasing and distribution needs of Digital. This runs the gamut from sourcing raw materials and parts to shipping final products. Groups described here include Purchasing, Corporate Distribution, Component Engineering, and Purchase Specifications.

10.1 PURCHASING
Manager: Jack Batten (ML1-5/B98, 223-3238)

Purchasing assures supply, competitive cost, timely delivery, and qualified materials. They develop purchase specifications, verify compliance, and ensure that we have one part number, one standard cost, and one face to the supplier.

Purchasing also influences strategic business decisions. They participate in the selection of materials to meet product, design, manufacturing, and administrative goals. The organization also supports Field Service and Marketing, and ensures a formal make-or-buy process at all levels in Digital. For further information, contact Barbara Birt, ML1-5/B98, 223-2634.

10.1.1 Engineering/New Products Purchasing
Manager: Tom Cavanaugh (ML5-3/E13, 223-3003)

The group serves the Northeastern engineering community with four distinct services: Support Purchasing, Project Purchasing, Materials, and Software and Systems Purchasing.

Support Purchasing services Engineering's everyday parts and equipment needs. These include inventory parts for breadboards and prototype requirements, new items, or out of stock items. They handle consultant, maintenance, and service agreements. They can also provide rentals of equipment and capital equipment such as testers. The group will also assist you in locating sources for engineering support materials. Finally, the group can find out who makes any part.

In order to assist you, the groups needs specification details, part numbers, and catalogue data if available. They also need quality standards, if applicable. An authorized Internal Purchase Requisition is also necessary for the group to do business with you. This authorizes the group to commit to a Purchase Order with an outside vendor. It must be completed by the requisitionor with all the necessary signatures. Without this information, order placement may be delayed. For more information on what is required of you, contact:

Phil Buscemi (ML5-3/R13, 223-5153)
Anita Spinney (TW/B15, 247-2645)

Contact the group whenever an engineering stockroom can't supply your needs. For common breadboard components, it's possible that the material will be in stock.

Because it costs Digital about $35 to place an order, administrate it, and generate a check to pay the vendor, it makes sense to group your small items whenever possible.

Project Purchasing works with design groups to source all new components including fabricated plastic and metal items. The group is organized by commodity specialty, handling active devices, passive devices, fabrication, and plastics.

The group establishes cost-effective sources, evaluating component and metal parts availability, lead time, and the capacities of outside sources. They communicate sourcing risks to both Manufacturing and Engineering, recommending effective risk management. Project Purchasing can also negotitate the most favorable preliminary standard cost, reflecting the proper balance among quality, technical conformance, and expected volumes of lot sizes. The group can also provide a "value analysis" using their external resources or vendor base.

Contact the group early in the concept stage of your project. They need sketches or preliminary line drawings with essential dimensions, and specifications. The format of these requirements is not important in the early phases of your project. For more information, contact:

Matt Habinowski (ML5-3/R13, 223-3229)
Bill McAllister (ML5-3/R13, 223-8946)
Charlie Sullivan (TW/B15, 247-2628)

Materials exists to aid design engineers in obtaining, controlling, and planning material for prototype builds. They act as an interface to Project Purchasing. As a project oriented group, Materials aids in documentation control at the preliminary stage by using a PCA (Purchasing Change Authorization) System. The group also structures and maintains, by way of the Parts Lists, an engineering Bill of Materials using software developed by Engineering New Products Purchasing specifically for this purpose. They maintain a product materials cost data base. Finally, the group drives processes for the timely resolution of materials issues among Manufacturing, Engineering, Purchase Specifications, and the Manufacturing plants.

In order to assist you, the group needs an Engineering Parts Lists, documentation (format unimportant), a willingness to work with the Purchasing Change Authorization (PCA) System, and an Engineering Business Plan (see DEC Standard 130) for a new product. Contact them during the concept stage of your product. For more information, contact:

Lino E. Mion (ML5-3/R13, 223-8987)
Vic Bellemare (ML5-3/R13, 223-8372)
Pam Hansmire (TW/C15, 247-2170)

Software and Systems Purchasing assists in locating and obtaining software packages, competitive hardware, and EDP (Electronic Data Processing) consulting services.

The group can supply you with the best available software to fit the function described. The group acts as a "clearing house" for the purchase of competive hardware. (Do we already have it? Should we buy it? Lease it?) The group can also put you in contact with those consultants who are able to perform the specified task in the time required. They will also handle all contracts, licenses, and agreements associated with the above.

The group needs a functional specification or a work plan to assist you. They would like to be involved in the concept stage of your project, or as soon as an outside acquisition is considered. For more information. contact:

Steve Hyde (ML21-1/T27, 223-4852)
Bob Mendelsohn (ML21-1/T27, 223-7519)

10.1.2 Corporate Purchasing/Commodity Management

Manager: Tom Grablick (ML21-1/P66, 223-2614)

This group prepares 2 to 5 year Business Plans for puchasing major commodities and critical raw materials. They ensure that suppliers have the capacity to provide for Digital's expanding material requirements.

The primary responsibilities of the group include coordinating all purchasing activities of today and the next 5 years and ensuring strategies are in place to improve the dollar value of expenditures under contract. Furthermore, the group attempts to reduce raw material costs and material acquisition costs, measure supplier performance, enhance buyer knowledge, and allocate resources and material.

10.1.3 Administrative Purchasing
Manager: Paul Mantos (MS/B87, 223-8317)

This group purchases office services, furniture, construction, travel, maintenance, computer supplies, telecommunications, and mail services.

10.2 CORPORATE DISTRIBUTION
Manager: Carl Kooyoomjian (ML1-5/B98, 223-9735)

This group plans, implements, and directs the efficient flow, storage, and handling of raw materials, in-process inventory, and finished goods from their point of origin to their point of consumption. They have representatives in Digital's plants, product lines, subsidiaries, and administrative groups.

The primary focus of Corporate Distribution is on making an efficient distribution network throughout Digital. Elements of the network include transportation, field distribution centers, warehousing operations, associated systems for communications and control, and handling and storage methods.

To assist you, the group can provide a profile of their product design criteria, and an estimate of warehousing and transportation costs and trade-offs. Finally, the group can give you an understanding of the impact of distribution costs on the end user.

If your product needs new distribution schemes, contact the group during the design phase of product development by calling:

Joan Labelle (Corporate Distribution) ML1-5/B98, 223-7192
Darlene Hoover (Domestic Distribution) NR1-2, 234-2375

Questions which must be considered for any new product include: Can the product be stored in our existing warehousing systems? Will a slight design change reduce the storage space required? Can the product be easily handled by Digital and external personnel and equipment? Is the product designed within the requirements for transportation? Can we cost effectively and safely, with a minimum of product damage, move the product?

10.3 COMPONENT ENGINEERING
Manager: Jim Ring (acting) (ML1-5/B98, 223-6607)

Component Engineering is an organization made up of three coordinated efforts: *Resident Component Engineering* (a component engineer is assigned to a specific design engineering group), *Corporate Component Engineering*, and *Plant Component Engineering*. These three groups are united in a phased plan to give support to the planning, introduction, and maintenance of purchased parts.

Component Engineering's goal is to ensure that Manufacturing uses high-performance, available, and cost-effective purchased components to build cost-competitive, quality Digital products.

The organization provides technical support and direction to Manufacturing and Engineering on the selection of purchased components. They provide the documentation to ensure that parts are procurable, testable, and compatible with Manufacturing processes.

Component Engineering knows vendor processes and materials which apply to Digital's needs. They can relate information concerning components from the part level to the application and system level.

They also have an awareness of industry trends, and the technology, strengths, and weaknesses of individual suppliers. They can anticipate and solve purchased component problems. Additionally, the organization has extensive lab facilities to evaluate components.

Component Engineering can provide you with consultation on application analysis, component evaluations, industry trends, and problem solving. There is also available an ECO (Engineering Change Order) service to cross products, the Assembly Library Module (ALM) - a library of physical dimensions and pin layout of various components, and data bases for CALDEC and IDEA systems used by Design Drafting.

For information about component vendors, the organization can supply you with a Qualified Vendor List, Master Parts File (contained in EPLS – Engineering Product Library System), component marking and identification, and purchase specification and qualification procedures.

Regarding component usage, Component Engineering can provide you with a BOM (Bill of Materials) Analysis (a rating of preferred parts used as listed in all BOMs), a used-on listing, and trends in component usage.

For component test and evaluation, the organization can provide you with incoming inspection specifications, and plans, procedures, and programs for inspections and tests.

Resident Component Engineering provides many services to Design Engineering. These include direction on new or preferred technologies for components, vendor liaison for specifications, testing methods, schedules, qualification requirements, and assistance in getting the product to Manufacturing by interacting with Purchasing, Specification Control, Incoming Inspection, Process Engineering, and Manufacturing.

The Resident Component Engineer can also communicate engineering requirements to Corporate Component Engineering. These requirements include schedules, Part Number Request Forms (PNRF), In Process Parts (IPP), and special projects.

Finally, the Resident Component Engineer maintains a knowledge of other componant group activities outside the domain of Component Engineering. These groups include fabrication, metals, chemical, LSI, etc. For more information on Resident Component Engineering, contact:

Leo Tiernan (ML6-3/E21, 223-2663)

Corporate Component Engineering provides many services to Design Engineering. These include application data, reliability data, and consultation on the manufacturing of components, orientations to component engineering procedures, training, and failure analysis. The failure analysis includes SEM (Scanning Electron Microscopy) evaluation, component cross-sectioning, photography, and Xray qualification labs.

To qualify components, typical tests include mechanical, electromechanical, electrical, electronic, life-testing, temperature cycling, flammability, humidity, gross leak testing, package integrity, chemical, hipot, solderability, and critical mechanical dimensions.

Component Engineering offers a half-day seminar for the Design Engineering community. They provide designers with the information required to make optimum use of Component Engineering resources. Topics covered include:

- New Part Introduction Process
- Engineering Change Orders
- Information Resources – The Purchase Part System
- Component Engineering Services

To enroll in the seminar, or for further details and manuals, contact Component Engineering at 223-4797.

Contact Component Engineering early in the design phase of your project. Prior to releasing your product to Manufacturing, the resident component engineer can assist you in introducing your product to Manufacturing. For more information contact:

Vic Valenti (Quality/Reliability) ML6-3/E21, 223-3067
Paul Nix (Electromechanical, Passive/Discrete/Magnetics) ML6-3/E21, 223-4558
Leo Tiernan (Integrated Circuits) ML6-3/E21, 223-2663

10.4 PURCHASE SPECIFICATIONS

Manager: John Peachey (ML5-2/P67, 223-2322)

For Engineering, Manufacturing, and vendors, this group writes, controls, and distributes all of the specifications required to purchase the materials needed to produce Digital's products.

Purchase Specifications is a central repository containing a wealth of purchased parts information. The group performs a variety of tasks:

Digital Part Numbers – Each properly completed and approved Part Number Request Form (PNRF) is assigned one of these numbers.

Purchase Specification Generation – The group researches, writes, and edits specifications to established formats.

ECO Processing – The group researches, writes, and processes ECOs to purchase specifications.

Electronic Data Processing Entries – Purchased parts data are coded and entered into the Purchase Spec Data Base and are batched processed daily into the Engineering Product Library System.

Purchase Specification Distribution – Purchase specifications are distributed via microfiche (updated weekly) and microfilm. These are distributed to reproduction and microfilm areas.

Component Index Books – The group writes, edits, publishes, and distributes these books which fall into three categories: multi-class, 90 class, and FCD (Functional Code Descriptor). All indexes are updated periodically and are available to you.

Bulletin Listing All New and ECO'ed Part Numbers – Every two weeks the group publishes this document with all new numbers recently assigned (with related data). It also includes recent ECOs received (with related data).

Incoming Inspection Procedures – These procedures are maintained under ECO control and distributed on microfilm and microfiche.

ROM/PROM Coordination – The group assigns pattern numbers, supplies "how to" information for documenting patterns, and coordinates the information with the Design Library, the LSI Test Center, and vendors.

VSMF (Visual Search Microfilm) – These are microfilm cartridges containing most vendor catalogues. By providing a vendor's name, you can be supplied with vendor address, phone number, local sales office and phone number, a list of products offered, and a catalogue sheet of these products. If you know what type of commodity you want, the VSMF can supply you with information about which companies manufacture it, and catalogue sheets from those companies. The VSMF also contains Military, ASTM, and UL Standards.

Qualified Vendor Listing - This information is sorted by Digital Part Number and available on microfiche machines. No hard copy distribution is available.

Purchased Parts Lists - This information is sorted by vendor part number and name and available on microfiche machines. No hard copy distribution is available.

Vendor Code File - This file provides you with the address, phone number, and vendor code number of each Digital supplier.

The group needs complete specification information from you in order to assist you. Sometimes you may be asked for additional component and vendor information to complete your purchase specification. You will be asked to review and sign-off a finished specification. Give the group sufficient lead time to establish priorities for completion, review, and approval of the specification.

A convenient "one-stop-shop" method of having your *Part Number Request Form* approved is to leave it and any attached data with Component Engineering. Component Engineering will arrange full approval and submit the PNRF to Purchase Specifications for part number assignment. If you desire, you can bypass the "one-stop-shop" method and obtain approval signatures and part numbers without assistance.

The Following DEC Standards will help you do business with Purchase Specifications:

DEC Standard 012 - Unified Number Code - All purchased parts must reflect a Digital assigned part number (e.g., 10-99 class) before parts lists/BOMS can be finalized, before Purchasing can order, and inventory control can process material.

DEC Standard 055 - Purchase Specifications - This standard establishes the general instructions and responsibilities for the preparation and control of Digital Purchase Specifications.

DEC Standard 100 - ECO Procedures - This standard establishes the procedures for writing, obtaining approval, and submitting the ECO to the Purchase Specifications ECO Coordinator.

For more information, contact:

Jim Boice (ML5-2/P67, 223-3187)
Carl Bull (ML5-2/P67, 223-5124)

SECTION 6

PRODUCT LINE GROUPS

Digital's three major product line groups are Commercial Products, Computer Products, and Technical Products. Each major product line group is made up of a number of discrete product line groups. The product line groups have been described as small companies within the larger corporation, each responsible for its own marketing, advertising, finance, production operations, and engineering (when needed), with a primary responsibility for marketing and market planning.

Most product line groups are based on a particular industry and its needs. The OEM (Original Equipment Manufacturers) product line groups, for example, exist to expand Digital's repertoire of OEM customers and to provide them with the support they need. ECG, the Education Computer Systems Group, caters to the education market: schools, universities, and armed forces training facilities. By adopting Digital's products that fit individual marketplaces, the product line groups are able to provide a wide range of specialized equipment and services geared to solving a customer's data processing problems.

Product line groups structure their product offerings around the needs of their particular customers. This structuring is based on a knowledge of how customers do business, what their problems are, and how our products can be designed to solve their problems and help them run their businesses more efficiently.

Therefore, it is very important that you have a clear understanding of customer needs. A product's capabilities and applications are valuable only if they are marketable. State-of-the-art equipment will remain just "art" unless there exists a customer for such equipment. Obviously, design engineers cannot design and implement products in a vacuum. They must look at products from the perspective of the customer.

Products which truly service the needs of the marketplace are more likely to happen when communication is developed between Engineering and the product line groups. Most of this communication and coordination of efforts is performed by Product Managers from Central Engineering. But they can't do it all. For this reason, it would greatly benefit you and the company if you gained some knowledge of the ultimate use and destination of products developed at Digital.

The following pages contain descriptions of what product lines exist, what products they market, what their applications are, and who to contact for more information.

1.0 COMMERCIAL PRODUCTS GROUP

1.1 COMMERCIAL OEM GROUP

Manager: Dave Schroeder (MK1-2/H32, 264-5502)

This group sells small business computers through resellers who add hardware or software value and resell the systems in commercial applications areas.

The group is the main OEM supplier in the commercial marketplace. Through this channel, the Commerical OEM GROUP has aquired 10–15% of the small business computer market, primarily in the general purpose data processing environment. The major strengths of the group are in the size of its current distribution network (over 500 commercial OEMs) and the strength and breadth of Digital's Field Service network.

The DEC Datasystem 150 (PDT), the DECstation series (PDP-8 based), both the DEC Datasystem 300 and 500 families (PDP-11 based), as well as word processing systems and the DECSYSTEM-20 and VAX 11/780 are available to OEMs through this group. In addition, the group sells hardware components to commercial "iron" (hardware only) OEMs.

The group is chartered to evaluate and develop marketing programs, support programs, and OEM policies on behalf of the entire Commercial Products Group. OEMs are selected by an OEM Review Committee following analysis of a prospect's marketing plans, financial statements, and cash flow figures. Commercial OEMs who choose to apply and who meet Digital's certification criteria are known as Authorized Digital Computer Distributors.

1.2 TELEPHONE AND UTILITY GROUP

Manager: Peter Jessel (MK1-1/D29, 264-7207)

This group provides computer systems to all telephone operating companies, postal telephone and telegraph administrations and telephone equipment manufacturers for telephone central office and business office applications.

Products sold by this group include PDP-11s, VAX 11/780s and associated peripherals and software. They also sell unique hardware and software products, and special services such as TELCO configuration control.

In the telephone industry, these products have applications in "switch" (i.e., exchange) monitoring and control, transmission monitoring, billing data acquisition, central office administration, order entry, directory assistance, off-line billing, and collection, verification, display, communications, and data network systems.

1.3 MANUFACTURING, DISTRIBUTION, AND CONTROL GROUP

Manager: Bob Savell (ML5-2/E50, 223-2239)

This engineering group develops systems based on PDP-11s and the VAX family of computers. These systems are sold as standard products to customers composed primarily of Fortune 500 companies engaged in manufacturing or distributing tangible products.

The systems are true distributed systems, designed as systems and not as a collection of components, to be maintainable and programmable from the host processor. The part of the system designed by MDC is the DEC DATAWAY, a 15,000 foot multidrop hardware and software communications system that allows the host to communicate with up to 64 remote, general purpose, small processors such as the LSI-11 or 11/23, or with terminals that have very high data integrity.

The group also designs terminals used on both the DATAWAY and on EIA (Electronic Industry Association) RS-232-C lines for a variety of data entry and data dissemination tasks. The combination of these products allows distributed system configurations for practically all applications in a manufacturing or distributing company. Examples of such applications include time and attendance, material control, labor reporting, work-in-process tracking, inventory control, order processing, word processing, and electronic mail.

The group also designs a line of process I/O modules. The systems configured around process I/O modules are used in applications from monitoring a single machine tool to controlling very large refinery processes.

2.0 COMPUTER PRODUCTS GROUP

2.1 WORD PROCESSING PRODUCT LINE

Managers: Bob Gray, Hardware Engineering (MK1-1/J14, 264-5874)
Bob Beck, Software Engineering (MK1-2G10, 264-5962)

This group designs and sells display oriented turn-key word processing systems and word processing software packages to all end-users and certain OEMs.

Word processing itself has been defined as "the transformation of ideas and information into a readable form of communication through the management of procedures, equipment, and personnel." From a practical point of view, it refers broadly to the increasingly sophisticated hardware and software that permits rapid and efficient production of ordinary paperwork and related communication media.

Word Processing's four major applications include general correspondence, the creation of contracts and other lengthy documents, the printing of personalized form letters, and asychronous communication possible with any conversational remote computer.

The Word Processing Product Line presently offers both word processing products and communications software.

2.2 COMPUTER SPECIAL SYSTEMS GROUP

Manager: Jerry Butler (HD, 264-6209)

This group is devoted to filling those customer needs not otherwise satisfied by Digital's standard volume offerings. In performing this function, Computer Special Systams (CSS) engages in two mutually complimentary and supportive businesses. First, they design and develop special hardware, software, or turn-key systems for specific customer applications. Second, they design and develop a wide range of hardware and software products which are application-oriented or complement Digital's standard product offerings.

To this end, the group has its own Marketing, Engineering, and Manufacturing organizations for software as well as hardware. CSS is spread throughout the world. In addition to having three Engineering/Manufacturing facilities in the United States, CSS has facilities in Canada, Australia, Japan, UK, France, Sweden, and Germany. Each facility has a marketing, engineering, and production staff, and is capable of designing and manufacturing products to special order.

CSS projects vary from very small, to large and complex, and from essentially "standard" products to tailored one-time systems with special hardware and software.

2.3 GRAPHIC ARTS PRODUCT LINE
Manager: Steve Gross (MK1-1/D11, 264-6118)

This group designs and markets typeset, classified advertising, editorial, and business Text Management Systems (TMS) based on the PDP-11 computer. The group's products have applications in printing (newspapers, in-plant, commercial), publishing (books, magazines), and radio and television. The group is also responsible for developing add-on equipment, and upgrading the more than 450 typesetting systems presently in use.

The Graphic Arts Product Line provides customers with four sets of turn-key applications packages: TMS, CPMS, EMS and CMS.

These products are used in pure typesetting systems for newspapers, trade typesetters, and captive plants. It is also used to provide text editing for business Electronic Data Processing applications programs written specifically for newspaper and commerical printers, and subscription fulfillment for magazine publishers.

This hardware may also be used for business Electronic Data Processing tools for development of individual programs (COBOL, RPG II, FORTRAN, DIBOL), and interactive page make-up systems.

2.4 TRADITIONAL PRODUCTS GROUP
Manager: Jack Learson (MK1-1/D11, 264-5761)

This group provides continuing engineering support to the customer using older systems and add-on hardware. The group also provides an outlet for used equipment, excess equipment, and small volumes of larger systems to support on-going needs in certain segments of the marketplace.

The group assumes product responsibility for most CPUs no longer actively marketed and manufactured. The group sells refurbished equipment, PDP-11/35, 40, 45, 55, XVM Systems, and PDP-15 Graphics. Its older traditional products include PDP-8, 8I, 8S, 8L, PDP-11/15, PDP-11/20, PDP-12, Industrial 14, PDP-16, and other 18-bit processors (PDP-10, DECsystem-10 and -20 traditional products are handled by the Engineering Systems Group, Paragraph 3.3).

All of the group's factory refurbished equipment is electronically and cosmetically perfect, updated to the latest ECO levels, and all of the equipment is subjected to the same rigorous testing as Digital's new equipment.

Employees may purchase equipment from this product line group for personal use. Contact the group for more information.

2.5 RETAIL PRODUCTS DEVELOPMENT GROUP

Manager: Ollie Stone (ML21-3/E87, 223-6617)

This group sells small computer systems bundled with application packages and associated products directly to small businesses through company operated retail stores. The group offers both products and services: computer systems, supplies, and accessories, seminars and training classes, and brochures, manuals, and system documents to keep customers fully informed about their application packages.

The group presently offers only one basic computer system with no choice of memory size. The customer gets one or two dual RX01s, optional WPS communication software, a choice between two printers (LQP or LA180), and a choice of six application packages. Aimed at the small business, the general purpose business application package consists of accounts payable, accounts receivable, payroll, invoicing and inventory control, and general ledger. Other application packages and computer systems are being developed for future sale.

2.6 ACCESSORIES AND SUPPLIES GROUP

Manager: Phil Campaigne (MK1-2/B14, 264-6804)

This group consists of two product line groups: Digital Computer Supplies, and Customer Spares – the product line group which supports Digital's self-maintenance customers.

2.6.1 Digital Computer Supplies

Manager: Phil Campaigne (MK1-2/B14, 264-6804)

This product line group offers a complete line of supporting products for Digipal's major products. Organized to provide responsive service to the world-wide Digital customer base, the group carries items that complete or complement a computer system. A distribution network allows 24-hour turnaround time for 95% of the products. Products supported by the group include: processors, storage systems, software systems, and communication terminals. Contact the managers listed below for more information about the group's products:

Processors and Software Systems, Walt Dunham (MK1-2/E13, 264-6811)
Communications and Terminals, Dave Gagnon (MK1-2/E13, 264-6807)
Storage Systems, Steve Grinley (MK1-2/E13, 264-6804)

2.6.2 Customer Spares

Manager: Phil Campaigne (MK1-2/B14, 264-6804)

This group supports customers who choose to perform their own maintenance. Customers are able to conduct a productive self-maintenance program because this group provides a number of services and products. For example, group members assist customers in establishing proper spares inventories.

The group develops spare kits for processors, tape units, disk drives, terminals, and other peripheral devices. It also offers a maintenance documentation service (MDS) – a microfiche library (available by subscription to customers) of all documents (except engineering drawings) used to maintain Digital's hardware products. The group also provides tool kits, maintenance equipment, and test equipment for Digital's products.

Contact the following managers for more information about their products:

John Gallagher (CPUs, Memories, Tools, Test Equipment) MK1-2/C15, 264-6982
Arnold Beauregard (Printers, Terminals, Communications Equipment) MK1-2/C15, 264-6980
Ed Young (Storage Systems Devices) MK1-2/C15, 264-6979
Jim Butler (LSI, Small Systems) MK1-2/C15, 264-5271

2.7 TERMINALS PRODUCT LINE
Manager: Chuck Bickoff (MR2-1/M64, 231-6629)

This group designs and sells terminals and terminal related products. The primary functions of the group are to develop and maintain high-volume distribution of selected terminals and related equipment, and influence Digital to develop and manufacture better, more reliable, and lower cost system components.

The group markets teleprinters (LA34, LA36, LA120), character-oriented printers (LA180), the VT52 and VT100, and intelligent terminals (PDT11/110, PDT11/130, PDT11/150) to large volume purchasers. They also sell several specialized versions of these products. These products are aimed at meeting customer needs in an endless variety of data and communications applications. Typical applications include timesharing, data capture, inquiry and response, transaction processing, telecommunications, desk top computing, word processing, and small, stand-alone business systems.

2.8 MICROCOMPUTER GROUP
Manager: Jim King (MR2-1/M64, 231-6632)

The primary function of this group is to market unbundled LSI-11 systems at the board level to customers who will purchase a required minimum volume. The group serves three classes of customers: high-volume users, low-volume users, and the home hobbyist.

The group sells the LSI-11 and its options, giving users the flexibility to buy the absolute minimal system and expand it to meet the requirements of the application. They also market tools for hardware and software development, such as the PDP-11V03 and PDP-11T03 development systems and evaluation kits. General purpose interfaces, clocks, analog-to-digital, and digital-to-analog converters, and communication options are available for the LSI-11/PDP-1103. Operating system software, including RT11 and RSX11S with languages, is also available.

These products have been designed to supply users with reliable, low-cost systems that can be used in industrial process control, inventory control, data formatting, preprocessing, and as developmental systems. A home hobby distributor uses many versions of the LSI-11 to provide his or her customers with kits. A photographic laboratory uses a version of the LSI-11 to obtain color separation balance when processing color films. A manufacturer of sheet plastic uses LSI-11s to control the thickness and the mix of the materials in the manufacture of the product.

3.0 TECHNICAL PRODUCTS GROUP

3.1 TECHNICAL OEM GROUP
Manager: Joe Meany (PK3-1/M86, 223-2837)

The OEM (original equipment manufacturer) buys Digital's products, adds substantial value, and resells or leases the products to a third party who is a separate corporate entity. If the end application of a computer is to be the management or control of a process or product, the OEM is defined as technical.

Applications for Technical OEM products include engineering and scientific (such as simulation, computer-aided-design), instrumentation (instrument control and processing of instrument readings), medical (patient monitoring equipment, CAT scanners, etc.), industrial, government and telecommunications, and computer system products where Dcgital's product controls the OEM's product, such as the Xerox page printer and COM (Computer Output Microfilm) equipment.

The value of OEMS may be found in the several contributions which they offer. They multiply the effectiveness of the sales force. They are a stimulus to high-volume manufacturing, resulting in lower product prices for everyone. They provide greater product exposure to first-time computer users who later may buy Digital's end-user products. Technical OEM sales account for approximately 20% of all corporate sales.

3.2 EDUCATION COMPUTER SYSTEMS

Manager: Charlie Rose (MR1-1/M40, 231-4360)

This product line group is a leading supplier of educational computing equipment, offering a range of products from small single-user systems to large mainframes.

This group provides minicomputer systems, related software and support materials for instructional applications in educational institutions, government, and industry. They also provide computer systems to assist in the financial and operational administration of educational institutions.

The group markets standard corporate PDP-11 and VAX-11/780 products. In addition, VAX-11 PASCAL, WISE, DECAL application software, and packaged systems are designed and sold.

They also provide DECsystem-10 and DECSYSTEM-20 mainframe computer systems, related software and support materials for administrative, instructional, and research applications in educational institutions worldwide.

3.3 ENGINEERING SYSTEMS GROUP

Manager: Pete Smith (MR1-1/M42, 231-5160)

This group provides PDP-11s, VAX-11/780s, DECSYSTEM-10s and -20s, and associated graphics and peripheral devices with computer aided design applications to industry segments and engineering disciplines.

For industry, these products have applications in manufacturing, government and utility engineering departments, architectural and consulting engineering companies, design and build companies, and construction companies.

For engineering disciplines, these products have applications in structural engineering, electrical and electronic engineering, and civil engineering.

The Engineering Systems Group has made major investments in generic engineering software and specific engineering applications software. Engineers interested in learning more about applications software packages in the areas of structural analysis, electronic design, or mechanical design, are invited to contact ESG. The product line group can supply you with information about functionality, Digital system configuration, availability terms, and contacts for specific programs. For specific application areas, contact:

Rick Gimbel (MR1-1/M42, 231-5154) Electronics
Lloyd McDaniel (MR1-1/M42, 231-5162) Mechanical Design
Jim Morrison (MR1-1/M42, 231-5159) Structural Analysis

The group also publishes an *Engineering Systems Software Referral Catalogue* twice a year. The most recent edition lists nearly 200 programs for such disciplines as Architectural Design, Structural Analysis and Design, Electrical/Electronics, and Management and Control. All packages run on PDP-11, VAX-11/780, DECsystem-10, or DECSYSTEM-20 systems. Catalogue copies can be ordered from Printing and Circulation Services in Northboro, order number EJ-17954-37.

3.4 GOVERNMENT SYSTEMS GROUP

Manager: Dana P. Lajoie (MR1-1/M85, 231-5467)

This group sells all of Digital's products to governments outside the U.S., and to the U.S. Government in Command, Control, Communications, Weapons Systems, Intelligence, and general Automated Data Processing (ADP) areas. They sell to prime contractors in the Command, Control, Communications, Intelligence, Weapons Systems (C^3IWS) business. They also sell products to all 36-bit Original Equipment Manufacturers.

Government Systems Engineering services the needs of these market segments and provides both hardware and software products. The group also provides consultation for the product line group on all products.

The Government Systems Engineering group has specialized expertise in computer networking, including ARPANET, interconnectability, high-speed channel interfaces, TEMPEST product engineering, and High Availability Systems.

3.5 LABORATORY DATA PRODUCTS GROUP

Manager: Bill Avery (MR2-4/E79, 231-6805)

This group provides computer systems, related software, and supportive materials for research and scientific applications in educational and non-profit institutions, medical research, industry, and government institutions.

The group seeks to address the following scientific and research applications:

- Realtime and/or off-line acquisition of scientific and research data
- Graphic display of this data
- Multifunction (real-time, batch, timesharing) manipulation and management of scientific and research data
- Control of and data acquisition from scientific instruments and experiments
- Development of programs for acquisistion, manipulation, simulation, and display of scientific and research data

The group's hardware development area can supply you with specifications, trade-offs, interconnection to other hardware, etc. The group can also tell you more about their applications, market size, and customers.

To assist you, the group needs a general product description with a statement of the impact of the new product on internal products. They also need developmental costs, a realistic schedule, a first-customer-ship date, and volume schedule. They would also appreciate major specifications with an analysis of the competition.

3.6 MEDICAL SYSTEMS GROUP

Manager: Raff Ellis (MR2-4/M79, 231-6928)

This group sells computer systems related software and supportive materials to the medical marketplace. The group sells specific products (e.g., GAMMA-11, a system used in nuclear medicine; MUMPS, a system used in clinical labs) to end-users and OEMs. They also sell equipment relating to clinical care, including patient data, to the medical marketplace.

Contact the group during the new product business planning stage at which time the Medical Systems Group may indicate a high level of interest.

The group can supply you with specifications, trade-offs, and interconnections to other hardware. They can also supply you with their applications, market size, and customer profiles. Other items include long-range and high-volume planning, inventory, and member's names for Product Steering Groups.

For hardware development issues, contact:

Bill Avery (MR2-4/E79, 231-6805)
Bernie Geaghan (MR2-4/E14, 231-6944)

For software development issues, contact:

Dirk Brinkman (MR2-3/E70, 231-5637)
Terry Weichmann (PK2/M21, 223-5911)
Bruce Bayuk (MR2-3/E70, 231-4046)

To assist you, the group needs a general product description, with a statement of the impact the new product will have on internal products. They also need an estimate of developmental costs, a realistic schedule, a first-customer-ship date, and volume schedule. They would also appreciate major specifications with an analysis of the competition.

SECTION 7

PROCESS MANUFACTURING
Manager: Will Thompson (ML1-5/E29, 223-8845)

1.0 MANUFACTURING NEW PRODUCTS
Manager: Joe St. Amour (ML1-5/E29, 223-2596)

This group coordinates Manufacturing's overall capabilities and strategies for Digital's future projects, managing the introduction of new products into Manufacturing.

The group can tell you who to contact for information about product costs, process design, schedules, and budget estimates. They will assign you a temporary Manufacturing 2x2 team partner for your "Before the Beginning" phase*. This will enable you to get Manufacturing commitments as you need them, before your permanent Manufacturing 2x2 partner is identified. The "Before the Beginning" phase is also a time when the group will help you put together your New Product team. At that time the plant that will build your product is identified and commitments from the plant are secured.

* Figure 7-1, General New Product Start-Up Plan, shows the major milestones in the life of a project from a Manufacturing perspective. Manufacturing must be allowed to participate in the planning of your project before the Phase 1 Business Plan is written. To achieve this, Engineering and Manufacturing must communicate with each other early in the new product's development. We call this working together "Before the Beginning". It plays a crucial part in our mutual goal of introducing Digital's new products on schedule, at quality, at cost, and to budget.

If you do not know who to contact in Manufacturing, call the New Product Manager responsible for the type of product you wish to introduce. This person will either help you himself, or direct you to the right people. New Product Managers and product types are listed below:

Al Smith (AC/B38, 232-2450)	- CPUs
Ed Tompkins (ML1-5/B95, 223-2523)	- Terminals
Guido Ciannavei (ML1-5/B94, 223-9724)	- Disks and Tapes
Gene Stringer (NI, 261-3058)	- FA&T (Systems Integration)
Ken Slater (WZ2-1, 238-2261)	- LSI
John Harrington (ML1-4/B21, 223-9452)	- General Manufacturing

Figure 7-1 GENERAL NEW PRODUCT START-UP PLAN

	MAJOR EVENT	PURPOSE OF EVENT	TASKS REQUIRED FOR EVENT TO OCCUR
1	IDEA PRELIMINARY APPROVAL GIVEN BY THE OFFICE OF DEVELOPMENT	To develop profitable new products for Digital.	1. Two page preliminary business plan written. 2. Preliminary business plan approved by OOD. RE: Corporate Policy Memo 75-8.
12	PHASE I BUSINESS PLAN APPROVED BY OFFICE OF DEVELOPMENT	To receive authorization for funding & other resources to complete product design, and to put in place other necessary product plans.	1. Customer need defined. 2. Solution defined in form of product. 3. Proposed product passed Design Review DEC STD 007. 4. Market projection evaluated as favorable & initial sales projections made. 5. Market strategy defined & approved to fit with overall strategy by the Product Line Managers. 6. Manufacturing capability/strategy reviewed & approved. 7. Field Service inputs received. 8. Engineering project head is identified. RE: Corporate Policy Memo 75-8. RE: There is no Business Plan without inputs by Manufacturing people.
3	PRODUCT DESIGNED	To freeze product definition and complete design to sufficient degree so that program can proceed on schedule & prototypes can be built which are of a design that manufacturing can build & product planning can be controlled.	1. Product Specification including: A. Functional specification, B. System configuration definition &, C. Reliability performance have been completely defined & frozen. 2. Product Specification is under change control. 3. Product Specification has been translated into design Mfg. can build. 4. Design has passed Design Review, DEC STD 007, Steps 2, 3, & 4. 5. Preliminary product documentation completed such that prototypes can be built. 6. Product design coordinated as appropriate with Mfg., Field Service & Product Lines.
55	PHASE II BUSINESS PLAN (MANUFACTURING PLAN) APPROVED BY MANUFACTURING ENGINEERING COMMITTEE	For New Product Team to publish & secure approval of a Manufacturing Plan which specifies & facilitates product schedule, quality, cost & budget so that every team member knows what to do & when, & so other parts of the company can proceed with product's plans based on New Product Team's commitment.	1. All parts of the Mfg. plan are completed, specifying product schedule, quality, cost & budget goals. 2. The strategy & resources for achieving goals have been identified by/for team members. 3. Plan has been approved by M-E Committee. 4. 2 X 2 Managers have been hired and installed. 5. Plan has been published & committed to by New Product Team. 6. All key functional New Product Team Managers have been hired & installed. 7. Provision has been made for the plan to be updated (rev control). 8. The Phase II Business Plan has been approved of which the Mfg. Plan is a part. Phase II requires a completed prototype.
67	LIMITED RELEASE OF PRODUCT DOCUMENTATION	To transmit all the product documentation from Engineering to Manufacturing, under change control, that manufacturing requires to begin securing material, people, & process equipment to be ready for the Pilot Run.	1. At least one prototype has been built, debugged, & is operating to the published product specification, functional specifications. 2. And to selected system configuration(s) specifications. 3. All build product documentation is complete, including fab, logic, assembly, etc., & 4. Is the same as the prototype unit 5. Has been signed off by both the Mfg. & Eng. 2 X 2 Team members 6. And is under change control. 7. DEC STD 007 Design Review Steps 5, 6, & 7 passed.
68	PRODUCT ANNOUNCEMENT	To announce the product to the outside world such that orders can be solicited & booked with full assurance that company contract commitments can be met.	1. The 2 X 2 Team has made final commitment to Mfg. cost. 2. Product pricing is finalized by Product Lines. 2 X 2 Team & Product Lines have agreed & commited 3. To build schedules 4. To build numbers and, 5. Configuration mix. 6. Product design has been sufficiently tested such that 2 X 2 Team can commit to product performance & reliability on a schedule. 7. Announcement package is complete 8. First Customer Ship is 3-6 months away. 9. Product has been announced.
69	PILOT RUN COMPLETED	To debug the actual mfg. process all the way through mfg. by building a small number of units before production of a large number of units is begun.	1. DMT, SMT, 102 & 060 tests have sufficiently qualified product design to justify risk of Pilot Run. 2. Product Lines & 2 X 2 Team have agreed & committed A. To build schedule, B. To build numbers, C. To configuration mix. 3. Pilot units have been built only A. Using latest rev product documentation B. Using latest rev process documentation. C. In selected Mfg. plant, D. By Mfg. personnel. E. Using process equipment & documentation to be used at production commencement. F. Completed pilots, as product will be shipped to 1st customers, has been successfully evaluated for: 1) Unit functionality. 2) System functionality. 4. All process documentation is under change control. 5. New Product Team agreed process sufficiently debugged to begin production. 6. Pilot strategy/method determined for future options, enhancements & configurations. 7. Product availability commitment for Field Service evaluation & training has been met.
70	PRODUCTION BEGUN	To produce units for sale: - on schedule - at quality - at cost	The following tests qualifying product design (on prototypes) have been completed, proving the product to the Product Specification 1. Design Maturity test for reliability & functionality. 2. System Maturity Test on selected (2 X 2 Team) configuration(s) for functionality 3. DEC STD 102, 060 environmental & safety. 4. Pilot run has been completed. 5. Continuous availability of sufficient material, personnel & other resources are assured. 6. PMT Plan is final drafted. 7. PMT has begun. 8. Construction of production units has begun. 9. Plan for transfer of product mfg. responsibility to steady-state plant organization agreed to by plant. 10. Field Service & 2 X 2 Team have agreed & committed to Field Service spares schedule & spares test process. 11. Design Review DEC STD 007 has been completed. (Step 8). 12. Final release of design documentation has been made.
71	FIRST CUSTOMER SHIPMENT MADE	To meet contractual commitment to first customer of the product.	Shipment of the 1st product unit has been completed. 1. At quality plan goal - unit & system level. 2. Field Service has accepted product. 3. Customer has accepted product.
72	PMT (PROCESS MATURITY TEST) COMPLETED	To conclusively demonstrate that the mature stabilized product is being produced to quality goal by a stable process so that process can be controlled.	The PMT plan has been carried out & has conclusively demonstrated, using a representative sample quantity of the product, that the process is sufficient to produce product at the desired end goals specified in the Mfg. plan of 1. Product at cost, 2. Product at quality, 3. Product at quantity, 4. A strategy/method plan exists for PMT of future process changes, ECO's & Product enhancements & options.
73	FIRST QUANTITY SHIPMENT MADE	To complete process of - initial product build meeting commitments. - Product documentation - Introduction strategy. - Transfer to steady state manufacturing organization in controlled & predictable manner.	1. Product is being shipped to schedule. 2. Product is being shipped at final quality goal. 3. Product is being shipped at interim cost goal. 4. Above has been achieved at Quantity, I.E., at a monthly rate which is 65% of the average of the monthly rates projected for the next 12 months. 5. PMT is completed. 6. Suitable product documentation is available for External Mfg. or another plant. 7. New Product Team members have been reassigned. 8. Plant organization has taken over responsibility for product manufacture.

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There are many sources of information about new products and their introduction to Manufacturing. The following list contains these sources and names of people to contact:

Source	*Contact*
General New Product Start-Up Plan A road map guide of what needs to be done to introduce a new product into Manufacturing	Group or plant new product managers or Brenda Buchanan (ML1-5/E29, 223-4278)
New Product Introduction Reference Library Collection of tools, policies, and sample plans relating to new product introduction; includes sample Manufacturing and PERT plans for various types of products	Group or plant new product managers or Brenda Buchanan (ML1-5/E29, 223-4278)
Project Planning Package Users handbook for planning a new product introduction and how to use PERTX, the PERT-based computer program for project scheduling	Brenda Buchanan (ML1-5/E29, 223-4278);also available in the Corporate Library
Slate Book Manufacturing plans to improve its new product introduction process	Joe St. Amour (ML1-5/E29, 223-2596)
Polka Dot Book Quarterly review of budgets, schedule, revised forecasts, etc., for all new products being introduced into Manufacturing (distribution is restricted)	Mel Black (ML1-5/F31, 223-5091)

Source	*Contact*
DEC Standard 130 - Guide for Product Business Plans The how and what to write for Phase I and Phase II business plans which are required to secure authorization and funding for new products	DEC Standards Administration (ML5-2/E56, 223-2954)
Manufacturing/Engineering Organization Directory A Who's Who? in Manufacturing	Barbara Burnham (ML1-5/E29, 223-2580)
Project Scheduler Training Manual A self-paced instruction guide on PERT scheduling	Brenda Buchanan (ML1-5/E29, 223-4278)

You can get assistance on two additional areas of interest to you. Process Consultants are available to explain the benefits and use of the Project Planning Package. They can assist you in the hiring and training of Project Schedulers. Additionally, Project Planners, members of the New Product team, are catalysts and keepers of the new products introduction plan. For more information, contact Brenda Buchanan (ML1-5/E29, 223-4278).

2.0 CORPORATE QUALITY ASSURANCE

Manager: Gene Mondani (ML1-5/E30, 223-2933)

This organization is made up of three groups: Reliability Engineering, Quality Assurance, and Manufacturing Product Safety. These groups are described below.

2.1 RELIABILITY ENGINEERING

Manager: Art Sturgis (ML1-5/E30, 223-4979)

This group ensures that a low-risk, economical product is introduced to high-volume Manufacturing. Normally this is accomplished through Design Maturity Testing (DMT).

Usually Engineering prototypes are submitted to the group for independent third party evaluation. Through a Review Action Team (RAT) with members representing Engineering, the group, and Manufacturing, a detailed plan is generated with Mean-Time-Between-Failure (MTBF) goals specified.

Contact the group during the design stage of your project. You should have established initial Engineering MTBF goals. Reliability Engineering will assign an engineer to chair the Review Action Team and issue the DMT plan.

2.2 QUALITY ASSURANCE
Manager: Darby Checketts (ML1-5/E30, 223-4414)

This group drives the certification of products and processes within Manufacturing. Product Managers and Project Managers should contact this group to understand the requirements for certification. The certification of a particular product means that:

- The product complies with all DEC Standards
- Design Maturity Testing has been completed successfully
- Process Maturity Testing is complete and a plan exists to ensure ongoing reliability
- Fundamental elements of a Manufacturing system to control for quality are in place
- Clear quality contracts exist between supplying plants and consuming plants
- Quality emphasis is on prevention rather than detection and correction
- Early product performance meets quality goals (functional performance as well as visual and mechanical quality)

These accomplishments make it possible for other organizations to reduce their dependency on retesting and other double checks. This way, Dock Merge, Field Merge, and other process optimization programs become possible.

The group can also supply you with overall direction to Digital's Quality organization and programs.

2.3 MANUFACTURING PRODUCT SAFETY
Manager: Bill Fischer (ML1-5/E30, 223-4198)

This group is the focal point for product safety and customer protection issues within Manufacturing.

The group ensures that manufactured products comply with DEC Standards with regard to product safety, consumer protection, and international regulatory issues. They provide functional direction to individual plant product safety coordinators to ensure safety issues are addressed in a uniformed and controlled manner.

The group also provides Manufacturing with an understanding of the requirements of outside regulatory agencies. They act as the principal liaison with these agencies on compliance issues.

Finally, the group is a focus for Manufacturing to address issues raised by the Corporate Product Safety Committee regarding product safety and consumer protection.

3.0 CENTRAL MANUFACTURING/ENGINEERING PLANNING
Manager: Arun Dube (ML1-5/E30, 223-7060)

This group manages the planning process for Process Manufacturing. They publish the "Manufacturing Technology Statement," which states the goals, strategies, and tactics of various Process Manufacturing groups to accomplish future product objectives. They coordinate the publication of the "Process/Product Technological Strategy," documents reflecting the strategy of processes in place and technical migration plans supporting product manufacturing objectives. These documents represent information from all Manufacturing groups.

The group also manages and funds Manufacturing Research and Development (PL97) projects so that Manufacturing's technological strategy is properly supported by projects to make the migration goals possible.

Contact the group when you wish to either know or influence Manufacturing technological goals, strategies, or tactics. Also, contact them when you wish to have new process capabilities funded or developed.

It will help the group if you communicate to them potential technological process applications for Manufacturing. If you have future technological needs dictated by design requirements, give the group time to initiate action.

4.0 INTERCONNECTIONS PROCESS

Manager: George Wood (AC/E44, 232-2300)

This organization makes up the bulk of Process Manufacturing. Major groups within Interconnections Process include Interconnections Process Management, Boards and Metals Process Management, Technical Systems and Services, and Manufacturing Test Applications. These groups are described in the pages that follow.

4.1 INTERCONNECTIONS PROCESS MANAGEMENT

Manager: Jim Melvin (AC/E48, 232-2310)

This organization is made up of several process management groups responsible for developing, implementing, and maintaining the strategic and operational plans to supply sub-assemblies to assembly Manufacturing:

Modules	- Ron Bohlin (AC/E48, 232-2576)
Power Supplies	- Tom Porada (AC/E48, 232-2442)
Backplanes	- Ed Sullivan (AC/E48, 232-2377)
Cables	- Hank Rauch (AC/E48, 232-2548)
Manufacturing Test Strategies	- Ed Gianetto (AC/E48, 232-7536)

The group develops five-year requirement and capacity plans with supporting strategies. They understand and manage the controlled growth of process technology, including

- Providing process operational information to groups developing new processes
- Working with process developers to determine new process acceptance criteria
- Supporting the implementation of new processes and process enhancements
- Determining the capabilities of existing processes and Digital's competitive manufacturing position

The groups also develop appropriate business and performance measurements. These measurements are used to realize the potential of processes.

Contact the organization if you would like to learn about interconnections processes including their current status, capabilities, and future plans. The groups can also tell you what techniques and technologies are being developed.

The groups can provide you with standard process documentation and explain how interconnections processes work. They can also tell you the status of Manufacturing locations, capacity, and loading.

The groups need from you designs which allow them to use the current processes to maximum advantage. They also request that you work with Producibility groups (see Section 7, paragraph 4.3.1) when designing new products.

Finally, when the capabilities of the existing processes do not meet the needs of future products, the Interconnections Process Management groups need time to react and information on how to react.

4.2 BOARDS AND METALS PROCESS MANAGEMENT
Manager: John Caulfield (AC/E44, 232-2544)

This group is made up of Process Management - Printed Circuit Boards, Central Mechanical Manufacturing Engineering, and Process Management Quality Assurance.

4.2.1 Process Management - Printed Circuit Boards
Manager: Don Pucci (AC/E44, 232-2534)

This group is responsible for developing, implementing, and maintaining the strategic and operational plans for the supply of printed circuit boards to Manufacturing.

They develop five-year requirements and capacity plans with strategies to meet such plans. They understand and manage the evolution of technology and its impact on in-plant environmental and safety aspects.

They determine Digital's competitive Manufacturing position, developing business and performance measurements. They also build new boards shops, developing the "make versus buy" strategy for printed circuit boards.

The group provides corporate commodity management for printed circuit raw materials and capital equipment.

Contact the group if you would like to learn more about the printed circuit board process including its current status and future plans. Also, contact the group if you would like to know what techniques and technologies are being developed.

The group can explain how the printed circuit board process works and help you understand the process capabilities. The group needs from you designs which allow them to use the high-volume process. They also request that you work with Producibility groups (see Section 7, paragraph 4.3.1) when designing new products.

4.2.2 Central Mechanical Manufacturing Engineering
Manager: Fred Oldfield (ML5-1/E31, 223-2235)

This group develops specific manufacturing processes that optimally suit the parts. They define and develop manufacturing tooling, inspection processes, and instrumentation. They also verify the process and quality capabilities of vendors.

For tooling engineering, the group designs, develops, and evaluates all new product tooling requirements, inspection guages, instrumentation, and assembly fixturing for production sites. They also evaluate and endorse all high-volume tooling contracts for concept and cost.

For mechanical computer-aided design/manufacturing (CAD/CAM), the group's goal is to integrate engineering and manufacturing functions, and to subsequently spread the technology throughout Digital. This is being accomplished by maintaining a computer laboratory used for both development and production. The development applications include pure Research and Development, training, system engineering, and special software generation. The production use includes design engineering, tool engineering, and N/C (numerical control) programming.

For advanced processes, materials, and technology, the group provides consultation and advice on all materials and process technology pertinent to the company's needs. They also verify and define new or improved technology.

When mechanical parts are involved, Manufacturing new Product Managers should contact Central Mechanical Manufacturing Engineering at project inception, where a Manufacturing team (consisting of Manufacturing, Quality Tooling Engineers, Process/Materials Specialists, and New Product Buyers) will work with the Design and Production organizations to develop schedules, budgets, tooling requirements, inspection techniques, and product cost goals. This team will remain part of the New Product task force until volume production goals are met.

An ad hoc product review committee evaluates the above requirements at the development of the Project Proposal. Participants of the review committee are:

- Design Engineering Team (2x2)
- Manufacturing Engineering and Department Specialists
- Tooling and Process Engineers
- Purchasing Team
- New Product Manufacturing Team (2x2)

This approach is useful in establishing a mutually agreed upon project strategy. It also unites the key participants in a cooperative working team.

To assist you, the group must be notified of your intention to introduce a new product into Manufacturing. They need preliminary engineering specifications and design concepts. They also need your participation in ad hoc product reviews and your intended volume production requirements.

4.2.3 Process Management Quality Assurance

Manager: Dave Baldessari (AC/M38, 232-2555)

This group develops and maintains an effective quality system for the Mechanical and Printed Wiring Board processes. They ensure maximum product quality levels in conjunction with other Process Managment objectives.

In addition to managing process quality functions and providing short and long-term direction, the group:

- Ensures adequate feedback exists between consumers and suppliers

- Manages the Material Research Lab to control paint and standards requirements (see DEC Standard 092, Finish and Color Standard)

- Establishes and implements necessary Manufacturing process standards

- Promotes product uniformity across Manufacturing facilities and vendors

- Promotes the full use of resources through such projects as:
    - ship-to-stock
    - source inspection
    - plant quality engineering resource sharing
    - printed circuit board qualification techniques
    - consultation on new plant inspection techniques
    - plant assistance to optimize internal controls

If a new plastic is being considered for use on a product, contact Dana DeBlois (ML5-1/P55, 223-3058) for U.L./C.S.A. testing. Contact the group if you are concerned about interplant product uniformity, or if you need clarification on printed wiring board or mechanical workmanship/quality standards. The group can explain to you the capabilities and limitations of inspection equipment used in the process.

To help you, the group needs designs that fit well within Manufacturing capabilities, and designs that enhance quality predictability. They need your attention to 1) tolerance interference considerations, 2) the standardization of similar parts when possible, and 3) clear identification of critical dimensions. When possible, limit the variety and introduction of new colors.

4.3 TECHNICAL SYSTEMS AND SERVICES
Manager: Len Greaney (AC/B24, 232-2447)

This organization provides Manufacturing with the resources for optimizing the manufacturability of printed wiring boards, modules, and backplanes. To do this, the group works with Engineering and Manufacturing to ensure that interconnect product designs are producible and make full use of Digital's Manufacturing capabilities. Additionally, the group generates and provides specialized (software) tooling to all sites for production builds.

These services are provided through two major groups: Producibility and Post Processing.

4.3.1 Producibility
Manager: Bob Marcucci (AC/E24, 232-2551)

Advanced Producibility – This is a project or systems-oriented group that supports Engineering and Manufacturing groups through DEC Standard 030 (Module Manufacturing Standard) and the Producibility Handbook (both of these documents are available from Standards and Methods Information and Control, ML5-2/E56, 223-2954).

DEC Standard 030 describes the module manufacturing capability of Digital and the circuit layout standards and procedures that allow that capability to be optimized. The standard contains all the rules that ensure the circuit design engineer a fast and economical module.

The group is responsible for developing tools and systems for applying design and documentation rules. They also educate Design Engineering and Engineering Services with regard to the requirements and benefits of Producibility. The group also works closely with the Advanced Manufacturing Technology Group (see Section 7, paragraph 4.5) offering their technical assistance.

Contact the group for an interpretation or clarification of producibility elements, design requirements, or constraints. Also, contact them when you have a need to change DEC Standard 030, or other documentation and control standards.

Pre-Design Producibility - This group, managed by George Ross (AC/B72, 232-2596) provides producibility guidance to Design Engineering, Engineering Services, and Manufacturing/Engineering groups at pre-design and design phases of interconnection products.

The group can provide guidance on how new boards should be designed to optimize manufacturing in all Digital Manufacturing plants. They can give you an understanding of the design constraints imposed by high-volume manufacturing. Pre-Design Producibility can also give you a complete description of board, module, and backplane fabrication, and assembly operations and methods.

Other services include developing Manufacturing and assembly operations and methods, costs, and design alternatives. The group will help analyze the impact of standard and non-standard designs on producibility.

The group maintains chairmanship of the Producibility Committee. This committee coordinates producibility issues with Engineering and Manufacturing on a scheduled basis.

Contact the group at the initiation of the design phase, at the development of a new packaging concept, or simply at the re-design phase of an existing product.

Pre-Design Producibility support services are available after you have filled out the Pre-Design Questionnaire (PDQ) as outlined in DEC Standard 030.

4.3.2 Post Processing

This group provides both systems and facilities for post processing (converting) the Engineering design data (part of the engineering release) into a form that can be used by Manufacturing build sites to produce boards, modules, and backplanes. This task is addressed by two groups: Data and Software Systems Engineering, and Manufacturing Tool Generation.

4.3.2.1 Data and Software Systems Engineering
Manager: John Ardini (AC/B72, 232-2380)

This group supports Manufacturing Tool Generation (MTG) by engineering the process of tool generation in the forms of systems and process development. Additionally, the group defines the interaction between Engineering and Manufacturing Tool Generation, and between Manufacturing Tool Generation and Manufacturing sites.

4.3.2.2 Manufacturing Tool Generation
Manager: Dave Symmes (ML1-1/H28, 223-8716)

Manufacturing Tool Generation is made up of two groups which provide services to Engineering and Production Manufacturing sites. These groups are Manufacturing Tool Generation Operations and Methods Engineering.

Manufacturing Tool Generation Operations

This group, managed by Mike Taplin (ML1-1/E24, 223-3513), develops the initial tooling package for the appropriate Manufacturing build site. They also support any subsequent product transfer and other Manufacturing needs for soft tooling.

The group provides an array of tooling to Manufacturing sites:

Board and Backpanel Fabrication

- Numerically Controlled Tapes for Drill Machines
- Master Artwork for Image Application
- Master Artwork for Soldermask
- Continuity Test Files for Bare Boards

Module Assembly

- Process Files for Insertion Library System (ILS)
- Numerically Controlled Tapes for Component Insertion
- Pantograph Templates
- Component Overlays on Mylar

Backplane Assembly

- Wirewrap Data and Listing Files for Wirewrap Using Gardner Denver (GD) or Numerical Control, Semi-automatic Wirewrap Machine

- Data and Listing Files for Either Automatic Wire Tester (AWT) or Backplane Automatic Test Systems (BATS)

Test Equipment Manufacturing

- Artwork and Drill Tapes for Testhead Manufacture (PCB)
- Wirewrap and Drill Tapes for Testhead Manufacture (UBON - Universal Bed Of Nails)

Methods Engineering

This group, headed by Leo Crosby (AC/H28, 232-7410), receives board, module, and backplane Engineering releases. The group ensures that tooling packages are acceptable and complete before transferring them to the appropriate Manufacturing site. This includes determining the method of manufacture, identifying tooling needs for Data and Software Systems Engineering and Manufacturing Tool Generation Operations, assuring producibility, and coordinating the completed tooling package for the Manufacturing site.

By reviewing the release packages and prototype hardware, the group identifies specific needs and areas of producibiltiy improvement for high-volume manufacturing. The group also coordinates the manufacture of prototypes.

Contact the group when you need information about how to release data packages.

To assist you, the Methods Engineering group needs to know what Manufacturing site you have in mind. They also need advance notice and copies of the board and assembly release documentation as soon as possible. Refer to DEC Standards 142 (Printed Circuit Release Flow) and 181 (Wirewrap Backplane and Wirewrap Module Release Process). This will make scheduling, package reviews, and producibility analyses easy.

The group also needs assurance that no short cuts were taken in the physical design process. You must stick to agreements identified in the pre-design producibility review. Finally, you must identify any unique requirements of the design that may not be evident in the release package documentation.

4.4 MANUFACTURING TEST APPLICATIONS
Manager: Bill Moran (ML5-2/E77, 223-5661)

This organization is made up of five major groups: Automated Manufacturing Systems, Module Test Programming, Manufacturing Test Support, Advanced Test Systems, and Power Supply Test Systems.

4.4.1 Automated Manufacturing Systems
Manager: Bill Schauweker (ML21-3/E87, 223-6059)

This group designs and develops software and hardware for Manufacturing systems that load and monitor test programs for CPUs, peripherals, and subsystems. They also develop software for equipment that automatically inserts components into circuit boards.

Manufacturing systems are designed also for online data collection and report generation. Systems supported are APT (Automated Product Test), ACT (Automated Computer Testing), and ILS (Insertion Library System). APT development and support is the group's primary function.

4.4.2 Module Test Programming
Manager: Jim DeBlasio (ML5-2/E77, 223-4512)

This group, primarily funded by individual Engineering groups, writes diagnostic software for automated test equipment used in testing modules at Manufacturing sites. This effort currently includes the GENRAD GR1792A and the ZEHNTEL TS400.

The group also evaluates new automated test equipment to be used as part of our standard Manufacturing process. Upon qualification and acceptance of the new tester, the group will assume programming responsibilities.

The essential focus of the group's responsibility is educating new design and test engineers on the requirements, capabilities, and limitations of the various automated test equipment available for testing their products in Manufacturing.

The group also gets closely involved with module designers early in the design process to determine if testing problems exist. "Testability" recommendations then are made so that they may be included prior to the completion of the design. The close working relationship is maintained throughout the project to incorporate design changes into the software in a timely fashion.

Digital Module Test

This group, supervised by Dick Danek (ML5-2/E77, 223-9467), creates testing packages for use in testing Digital modules on the GENRAD GR1792A. This effort involves writing and debugging diagnostic software, designing interface circuitry and "Bed of Nails" fixturing, and creating documentation for the package.

Analog And Hybrid Module Test

This group, supervised by Chandrakant Shah (ML5-2/E77, 223-5679), develops in-circuit inspection test programs for testing power supply and hybrid modules on the TS400. This effort involves writing and debugging the diagnostic software, designing "Bed of Nails" fixturing, and creating documentation for the test package.

4.4.3 Manufacturing Test Support
Manager: Ray Lechevet (ML5-2/E77, 223-4555)

This group provides internal and external diagnostic support for module, subassemblies, and components. The group is divided into four functions: Field Support, Central Standards, Hardware Support, and Internal Support.

Field Support

This group, supervised by Tim Kelley (ML5-2/E77, 223-5289), provides diagnostic program support to Manufacturing on modules, subassemblies, and component test systems. The group supports the GENRAD GR1792A and ZEHNTEL testers.

Central Standards

This group, supervised by Walt Carlson (ML5-2/E77, 223-5278), supports the GR1792A, ZEHNTEL, APST (Automated Power Supply Test), Integrated Circuit Tester, and the Dedicated Tester. The group's primary responsibility is to support, coordinate, and control the release of test program standards, ECOs (Engineering Change Orders), problem reports, and quality assurance programs during the product life cycle of Manufacturing diagnostics for modules, subassemblies, and components.

Hardware Support

This group, supervised by Steve Garner (ML5-2/E77, 223-5253), supports the GR1792A, ZEHNTEL, and APST (Automated Power Supply Test). The group also supports and coordinates the hardware fabrication and documentation needs of these test systems. They work with Manufacturing sites on resolving integration and fixture problems.

Process Support

This group, whose principal engineer is Allen Williams (ML5-2/E77, 223-7659), provides diagnostic training for the test systems used within Manufacturing Test Applications. The group also trains Manufacturing site support personnel. Additionally, they are responsible for supporting the module test process at Manufacturing sites.

4.4.4 Advanced Test Systems
Manager: Dick Albright (ML3-4/T35, 223-7738)

Advanced Test system is made up of three groups: Advanced Development, Component Test Systems, and the Dedicated Test Group.

Advanced Development

This group, supervised by Van Spirose (ML3-4/T35, 223-7738), provides Digital with expertise in software to determine where automatic test equipment is needed. The group identifies needs for in-house designed equipment, and evaluates the test equipment of vendors.

Component Test Systems

This group, supervised by Paul Hale (ML3-4/T35, 223-3882), supports Component Engineering with two activities. First, they provide test software for SSI and MSI components and participate in release and support activities. Second, the group provides software tools to aid component engineers and reduce test development time.

The group also provides software tools for the Digital Module Test group, and models LSI devices for the Digitest simulator.

Dedicated Test Group

The group, supervised by Bharat Patel (AC/B73, 232-2326), writes Dedicated diagnostic programs for specific applications in Manufacturing. They also modify existing diagnostics for specific applications. Finally, the group acts as the Manufacturing liaison to specific Engineering diagnostic groups for future products.

4.4.5 Power Supply Test Systems
Manager: John Friedrich (ML5-2/H15, 223-6909)

The Power Supply Test Systems (PSTS) group is responsible for the test portion of the standard power supply test process. This includes systems, applications, and support.

System Development

This group, supervised by John Herrmann (ML5-2/H15, 223-4664), is responsible for developing hardware for test systems that test the power supply manufacturing process.

Applications Development

The group, supervised by Ralph MacKenzie (ML5-2/H15, 223-3507), develops test software and fixturing for supplies that are tested on the APST (Automated Power Supply Tester).

Product Support

The group, supervised by John Friedrich (ML5-2/H15, 223-6909), provides plant support for products (hardware and software) developed by Power Supply Test Systems, or other groups.

4.5 ADVANCED MANUFACTURING TECHNOLOGY
Manager: Joe Chenail (ML1-5/E29, 223-2421)

This group is responsible for forecasting and investigating new technologies necessary to manufacture Digital's products over the long term. For any new process, it is necessary to demonstrate its feasibility and determine the return-on-investment to ensure the long-term competitiveness of Digital Manufacturing.

Advanced Manufacturing Technology works specifically in three technology areas:

- Module Assembly Development
- Module Test Development
- Printed Circuit Board Development

Following the investigation and initial development, new processes are refined and introduced into Manufacturing by the Applied Technology Group. In addition to being active in new process development, this group is closely involved with certain new product introductions. Those new products that seem to have a significant impact on a manufacturing process are selected to be introduced via the Applied Technology Group where intensive effort may be applied toward the development or refinement of the manufacturing process for those particular products.

The success of this group depends heavily upon an accurate understanding of long-range trends in Digital product designs and applicable technologies. Contact the group when any new product requires a change in manufacturing processes. This must be brought to the attention of the group as early as possible. For more information, contact:

Module Assembly Development, Dave Widder, (232-2240)
Module Test Development, Nick Wells, (232-2441)
Jerry Jeansonne, (232-2478)
Printed Circuit Board Development, Gowri Sankar, (232-2506)
Applied Technology, George Katronge, (237-2344)

SECTION 8

INFORMATION SERVICES

1.0 DIGITAL LIBRARIES

There are several libraries located throughout Digital. The largest is the Corporate Library located in the Maynard Mill (ML4-3/A20). This central information bank for business and technical information is available to all employees, regardless of location.

The Corporate Library provides reference books, periodicals, research reports, standards, Digital and competitors' public documentation, audio and visual cassettes, inter-library loans, abstracts, definitions, industry news, and SCAN searches (a service that finds out what has been written on specific job-related topics). Their Purchasing Department handles individual and departmental requests for books, subscriptions, memberships, and competitive materials.

Table 8-1 lists the many libraries located throughout Digital. Not all libraries carry a full range of services. Contact the librarian at the branch nearest you for further information.

TABLE 8-1 Digital Libraries

NAME	LOCATIONS	LIBRARIAN/MANAGER	DTN
Maynard	ML4-3	Ralph Coffman	223-6231
Marlboro	MR1-2	Michelle Johnson	231-5040
Merrimack	MK1-1	Nancy Jones	264-5482
Salem	NI	Charles Mathews	261-2254
Tewksbury	TW	Mary Jane Zanca	247-2643
Westboro	WZ2	Joyce Ward	238-2544
Westminster	WM	Karen Delbert	241-2537
Colorado Springs	CX	Chris Blake	522-3116
Software Standards	ML12-3	Pat White	223-4094
DEC Standards	ML5-2	Doris Bellemare	223-2954
Market Data Center	PK3-1	Mary Headley	223-2504
VSMF	ML5-2	Carl Bull	223-5124

The Corporate Library is not the only place you can go for information. Another library is the Software Standards library. This library maintains a file of ISO, ANSI, FIPS, ECMA, CCITT, and Corporate Standards. Standards and Methods Information and Control can supply you with hard and microfiche copies of DEC Standards. The Market Data Center is a source of marketing and competitive information. The VSMF (Visual Search Microfilm File), maintained by Purchase Specifications, contains manufacturing information, vendor information, industry manuals, specifications, and standards, and military and federal specifications and standards. Some of these libraries are described in detail elsewhere in the manual (see index).

2.0 INTERNAL DATA SERVICES AND PRODUCT SUPPORT

Manager: Bill Svirsky (PK1/E33, 223-3615)

This organization manages the Corporate Data Center (CDC). The Corporate Data Center provides timesharing services and auxiliary processing with a minimum of production type processing. Additionally, the CDC specializes in the installation and support of user-dedicated medium and large scale DECsystems.

The CDC handles matters ranging from document generation to software program development. The group can supply you with many services:

- Timeshared services on a DECsystem-10 and a PDP-11 running RSTS/E from 8:00 A.M. to 6:00 P.M. everyday (Eastern Time).
- Public terminal areas are located at ML3-5, PK3-1, and MR2-1.
- Remote Job Entry stations (RJEs) are available at the public terminal areas listed above, providing fast and convenient turnaround to the user of small to medium-sized listings. Listings may be printed the sites listed above. Deliveries are made by Central Services.
- Support for all standard DECsystem-10 software including

  FORTRAN (Formula Translator)

  COBOL (Common Business Oriented Language)

  MACRO-10 (Assembly Language for the DECsystem-10)

  BASIC (Beginner All-Purpose Symbolic Instruction Code)

  ALGOL (Algorithmetic Language)

  BLISS (Programming Language)

  MIMIC (A Major Simulation Package)

- Support for all standard PDP-11 (RSTS/E) software.
- Support Preparation (provided by Corporate Information Handling Services) puts handwritten material into machine readable form, including *editing* for RUNOFF output (RUNOFF is a program that allows clean-looking printouts of ASCII files), *transcription*, and *assembly/compilation*.

To assist you, the group needs your project number and your programmer number. They also need your password. You may obtain these items by contacting Customer Assistance (Norman Shakespeare, PK1/E33, 223-4247). Request a CDC Systems Access form.

Customer Assistance is primarily a liaison between users and other groups within the Corporate Data Center. However, they are ready to respond to any questions or problems you may have regarding systems hardware or software, systems policy, or systems procedure.

Customer Assistance also offers monthly seminars on topics of interest to the CDC user community.

DECsystem-10 manuals, and RSTS/E manuals, are available from the Software Distribution Center (SDC) in Maynard (ML11-3) to assist both the novice and experienced user.

3.0 MARKET DATA CENTER

Manager: Jerry Todd (PK3-1/S52, 223-3631)

The Market Data Center provides a central source of marketing and competitive information that can be used by all product lines groups, Sales, Planning, and Engineering personnel. There are three areas that make up the Market Data Center: the Market Data Research Center, the Customer History Data Base, and the Prospect Data Files.

3.1 MARKET DATA RESEARCH CENTER

Manager: Mary Headley (PK3-1/S52, 223-2504)

The Research Center collects and organizes marketing-related information, answers reference inquiries, aids in research for specific projects, lends reports to requesters, and distributes the monthly Market Data Center Memo, a review of newly acquired reports. They maintain a collection of market research reports, directories, competitive files, and various marketing statistics and publications. Most notable are the following:

- *Market Research Reports* – The current collection consists of over 700 reports with subjects that range from in-depth analyses of specific products to broad overviews of certain industries. Information programs subscribed to include the following:

  - Stanford Research Institute's Business Intelligence Program
  - International Data Corporation's Corporate Planning Service
  - Quantum Science's MAPTEK Program

  These services supply marketing reports of all types on a regular basis.

- *Competitive Files* – These files consist of general, publicly available information on Digital's competitors. Information in these files is collected from current newspaper and magazine articles, news releases, company brochures, and manuals. A selected group of product manuals is also maintained, including manuals of IBM, Data General, Hewlett Packard, Honeywell, and Sperry Univac.

- *Reference Manuals* – Auerbach, Datapro, and others

- *Annual Reports* – Fortune 500 Companies

- *Consulting Organizations/Data Sources* – Organizations involved with marketing research
- *International File* – Contains market-sizing information on the foreign marketplace
- *Reference Books* – Including Dun and Bradstreet Directories, Thomas' Register, Moody's, Standard and Poors, State Industrial Directories, Who Owns Whom Directories, Industry Surveys, Industrial Outlook
- *Periodicals* – Including Harvard Business Review, Journal of Marketing Research, Sales Management, Fortune, Duns, Forbes, Datamation, Computerworld, Electronic News
- *Industry Newsletters* – Including Electronic Data Processing (EDP) Industry Reports, Autotransaction Industry Report, EFTS Industry Reports, Small Business Computer News, Micrographics Newsletter, Packaged Software Reports

3.2 CUSTOMER HISTORY DATA BASE

Manager: Jerry Todd (PK3-1/S52, 223-3631)

This is a computerized data base of Digital's U.S. and Canadian customers, showing bookings back through the fiscal year of 1972. At present, there are only a limited number of scheduled output reports (all quarterly). There are volume analysis reports for NORAM, NORAM Regions, National Accounts, and Product Lines. All other requests are handled on an individual basis. Normal turnaround is two to three business days.

3.3 PROSPECT DATA FILES

Manager: Tony Kramer (PK3-1/S52, 223-3672)

These files provide computerized data bases identifying and describing computer installations. They include International Data Corporation's Worldwide Computer Installation Data File, International Data Corporation's OEM/Systems House Data File, Mini-Micro Systems Annual Market Survey Data File, and selected portions of Dun's Marketing Identifier data file.

Printouts of these files are maintained and custom-tailored prospecting runs can be arranged.

SECTION 9

CUSTOMER SERVICES
Manager: Jack Shields (PK3-2/A58, 223-2548)

The Customer Services group is made up of four major organizations that are crucial to the continued development of Digital's business: Educational Services, Field Service, Customer Service Systems Engineering, and Software Services. These organizations are described in the paragraphs below.

1.0 EDUCATIONAL SERVICES
Manager: Del Lippert (BU/E17, 249-2200)

The primary purpose of this organization is to communicate information. The organization helps customers and employees make better use of Digital products by acquiring new skills and knowledge.

Over 1200 employees produce courses and instructional packages. They also produce technical publications (in print and microfiche), and offer book and media services. Last year the organization operated 218 classrooms at 19 worldwide training centers, presenting 251 different courses. They provided 500 computer systems for use in 2.1 million student hours of instruction.

They also produced 20,000 color slides, 11 million microfiche sheets, and published nearly one million volumes of technical manuals.

Basically, the organization is a conduit for technical information. They gather, interpret, organize, and then disseminate information in the most effective and efficient medium.

The organization has tied their course development people and technical writers to Digital's seven Engineering sites across the U.S. and Europe. Their goal is to make sure that courses and publications reflect state-of-the-art information via the latest media and methods. For example, the organization develops new audiovisual courses, uses modern instructional technology, and employs computer-generated graphics, visuals, and typesetting.

Using information from Engineering, Marketing, Software Services, and Product Support, the organization transforms this data into three basic products:

- *Instructional Services and Products*
  (lectures and lecture/lab documentation, self-paced and computer-aided instruction)

- *Technical Documentation*
  (tech manuals and microfiche, and published books by Digital Press)

- *Media*
  (corporate wide resource for artwork, video tapes, slides, photography, audio tapes, and educational writing and editing)

Educational Services serves customers, Field Service technical and management people, Corporate Information Service, and any other group that needs their services.

Engineers should contact the group on any of the following occasions:

- When you want to take one or more courses
- When you want to work with course developers (from the start of your product design)
- When you want to work with technical writers on documenting your new hardware product
- When you want to write a book for Digital Press
- When you need visuals, typography, editing, writing, or audiovisual support services for an upcoming paper or presentation

To enroll in a course at one of the training centers, or at an ILC (Individual Learning Center), contact Bedford (249-2976).

To obtain an Employee Catalogue and more information about courses available, contact Joluut Vanderhooft (U.S. Employee Education Manager), BU/E06, 249-2201.

For technical documentation and course development assistance, contact Joe Santini BU/E02, 249-2387 or any of the site managers:

Maynard:	Jack Cromwell (PK3-1/T12, 223-2487)
Merrimack:	Jack Cromwell (MK1-2/M26, 264-6600)
Tewksbury:	Judy Jurgens (TW/D04, 247-2621)
Marlboro:	Bob Hymes (MR1-2/T17, 231-6238)
Colorado:	Dick Lennard (CX, 522-3120)
Bedford:	Don Elias (BU/E06, 249-2207)
Reading:	Stuart Smith (RG, [44]-(734)-58-3535)

For Media Services, contact Lee Katz (BU/E35, 249-2067).

For Digital Press, contact Marcia Kenah (BU/E44, 249-2072).

2.0 FIELD SERVICE

Manager: Dick Poulsen (PK3-2/S87, 223-7429)

Field Service administers installation, repair, and FCO (Field Change Order) service to all of Digital and its customers.

In-house Field Service, managed by Ed Dorr (PK3-1/S16, 223-2132), repairs equipment and performs the reconfiguration of equipment. They will install new parts, move equipment, and maintain all of Digital's equipment on a contract basis.

Field Service Product Support, managed by Mike Kallagher (PK3-2/S17, 223-2124), is responsible for equipment installation and warranty work for all of Digital's product line customers. This is a separate product line group with profit and loss responsibilities.

Field Service provides preventive as well as remedial maintenance on a wide variety of products. The group has more service locations, personnel, and resources to offer customers than any other minicomputer vendor. There are over 350 strategically located facilities and 5800 systems-trained service representatives worldwide. Product support from district, regional, and corporate headquarters is available to all locations.

Field service should be contacted when technical questions about installation occur. The group can address such issues as power requirements for installation, environmental impact, cooling and space requirements, etc.

Field Service provides the customer with these services:

- Fast response time
- Guaranteed uptimes
- Penalty clauses
- National service agreements
- Price Flexibility
- Optimal configurations for uptime/maintenance considerations
- Maintenance of non-Digital supplied equipment

Field Service maintenance groups offer assistance to branch or district groups by providing engineering expertise for products in the field. These groups work closely with engineers designing and developing a product so that Field Service will be able to maintain it later.

3.0 CUSTOMER SERVICE SYSTEMS ENGINEERING

Manager: Don Busiek (PK3-2/S17, 223-2361)

This organization introduces new hardware and some software products into the field, ensures that reliability and maintainability strategies are in place to keep product life cycle costs low, and conducts research studies in branch office modelling, life cycle costing, repair strategies, and logistics. Groups which make up the organization include Maintainability Engineering, Customer Service Engineering, New Methods, and RAMP (Reliability and Maintainability Program).

MAINTAINABILITY ENGINEERING

Groups which make up Maintainability Engineering participate in the design of new products (both hardware and software) in order to supply the Engineering development team with:

- Reliability, Maintainability, and Availability requirements

- Service delivery requirements

- Cost trade-offs that help generate lowest life cycle cost

- Competitive service information to help set goals for cost of ownership at both option and system level

In this role, these groups will develop Field Service Maintenance and Business Plans as well as the project schedule.

Contact the Maintainability Engineering groups during the planning process of product development. Contact should be made as early as possible, i.e., when product proposals and the Phase 0 proposals are being developed.

Maintainability Engineering groups can provide financial and technical information during the initial planning phase. The groups can help ensure that the Business Plans are complete and help you avoid surprises after the major product goals have been established. They will be stressing cost of ownership and reliability as a major project objectives.

The Maintainability Engineering manager coordinates the activities of the Customer Service group (See Figure 9-1, Customer Services and Engineering Development) to provide maintenance plans and schedules. The manager will assign an engineer to the project during the initial planning and design stage. After receiving specifications, schedules, and cost estimates, the engineer will generate:

- Impact Statements
- Maintenance Plans
- Field Service Business Plans
- Cost/Benefit Studies
- Schedules for Coordinating Customer Service Activities

The engineer also alerts the Pricing Policy Committee of new product activities for product support and announcement.

In order to help you, Maintainability Engineering needs from you a Project Specification, Business Plan, Project Schedule, Product Test Plan, Product Field Test Plan, and a Certification Plan. Additionally, performance data is required for all network products.

The following groups make up Maintainability Engineering:

3.1 SMALL/ HARDWARE

Manager: Art Zins (PK3-2/H17, 223-2010)

This Maintainability Engineering group is responsible for the PDP-8, advanced PDP-11 products, memories, tapes, disks, terminals, power systems, and mechanical packaging.

3.2 SMALL/MEDIUM SOFTWARE AND COMMERCIAL SYSTEMS

Manager: Henry Adelman (PK2/S44, 223-2638)

This Maintainability Engineering group is responsible for new applications systems products and systems products of small and medium software and commercial systems, excluding large systems and Digital communications products. Product lines supported include Graphic Arts, Computer Special Systems, Word Processing, TELCO, and Commercial OEM (Original Equipment Manufacturer).

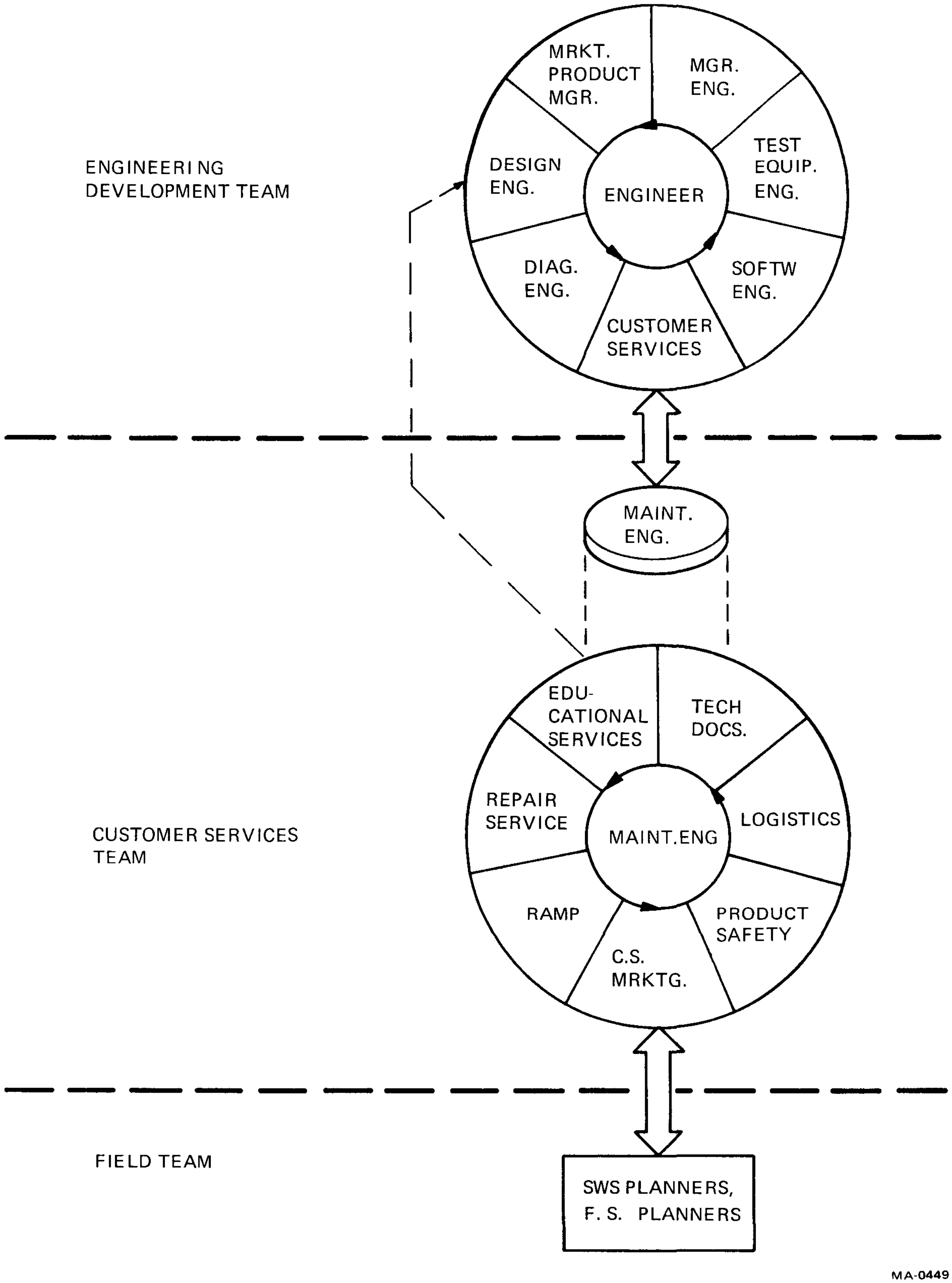

Figure 9-1 Maintainability Engineering

3.3 DISTRIBUTED SYSTEMS
Manager: Dick Pigman (PK3-2/S17, 223-7982)

This group is responsible for the serviceability of networks and network products. This includes both hardware and software communications products.

3.4 LARGE SYSTEMS GROUP AND PRODUCT LINE HARDWARE AND SOFTWARE
Manager: Walter Manter (MR1-1/S35, 231-6503)

This Maintainability Engineering group is responsible for new Large Systems Group hardware and software products. Product lines supported include Digital Components Group, Manufacturing Distribution and Control, Technical OEM, Engineering Systems Group, Commercial LSG, Government Systems Group, Laboratory Data Products, Medical Data Products, and Educational Products Group.

3.5 CUSTOMER SERVICE ENGINEERING
Manager: Chris Ball (PK3-2/H29, 223-3040)

Remote Diagnosis Engineering develops the remote diagnosis maintenance tools for PDP-11, VAX, and the DECsystem-10 and DECSYSTEM-20 families of products on a worldwide basis. The group provides support to existing and planned Digital Diagnostic Centers. This support takes the form of new host software development, host software enhancements, problem resolutions, and support to existing hardware designs (consoles). For existing hardware designs, support includes problem analysis, the incorporation of ECOs (Engineering Change Orders), modification of equipment for other countries, and approval by Postal Telegraph and Telephone authorities for hookups on their telephone lines.

The Remote Diagnosis Engineering group provides consultation to CPU and Peripheral design groups for the purpose of making new products remotely diagnosable. They also provide the analysis required to determine if new opportunities are possible by remote diagnosis.

Contact the group, via the Customer Services engineer assigned, during the conceptual phases of any central processor or intelligent subsystem that is to be remotely diagnosed. The group will provide the remote diagnosis plan that will include hardware to be connected to the unit under test, and the diagnostic script to be run in the host computer. You will be required to furnish the group with a set of maintainability goals and objectives for the product, and specify the Remote Diagnosis port interface.

Small Systems Engineering, managed by Scott Johnson (TW/C18, 247-2531), develops portable, self-contained, computer system testers. The testers are used to reduce service time and increase the number of service calls a service engineer can make in a given day.

This group will provide support and consultation to new products (Maintainability Engineering) groups, and help them define diagnostic and engineering hooks into their products. Small Systems Engineering will also provide the direction and analysis required to determine new opportunities and ensure continued development of the service strategy for the small systems marketplace.

Contact the group, via the Customer Service engineer assigned, during the conceptual phase of the new product to establish applicability. A functional description and preliminary specifications defining the product are required. Small Systems Engineering will supply you with a functional specification, defining the interface hooks necessary for using testers in your product, along with an orientation about the application.

Product Safety, managed by Ron Minezzi (PK3-2/H10, 223-3122), ensures that all hardware products meet the requirements of DEC Standards 060 (Digital Policy Relating to Nationally and Internationally Recognized Testing Laboratories) and 119 (Digital Policy and Practices Relative to Product Safety).

All applicable products must be UL listed, be certified by the Canadian Standards Association (CSA), and they must comply with International Electrotechnical Commission (IEC) 435. Furthermore, for products marketed in Germany, the appropriate VDE requirements must be met.

Listings and Certifications are always obtained through the Product Safety Group. You should subject your product to Product Safety Reviews at the conceptual, breadboard, and prototype stages. The group will consult with the engineer on Product Safety design requirements, they will review and test the product for compliance with DEC Standards, and they will obtain all U.S. Listings, CSA Certifications and similar test house approvals. You will be required to supply Product Safety with product specifications, a product demonstration, and samples.

The Product Safety Group also investigates all potential product safety problems. You are required to support all such investigations regarding your product until all problems are solved.

Micro Products, managed by Joe Belliveau (PK3-2/S77, 223-3983), investigates and recommends new service techniques required by the increasing use of LSI (Large Scale Integration) devices and micro processors. The group also conducts technological investigations and determines the field reliability of components, making recommendations for improvement.

Contact the Micro Products group via the Customer Services engineer when information is needed about the performance of components in field applications. Also, contact the group when you need information about the impact of packaging schemes on serviceability. Micro Products can provide you with information about component performance when you make a detailed request.

3.6 NEW METHODS
Manager: Steve Davis (PK3-2/S53, 223-3884)

RAMP Measurements Group, managed by Sy Feldman (PK3-2/S53, 223-7822), monitors the measured Mean-Time-to-Repair (MTTR) and the Mean-Time-Between-Failures (MTBF) of all major options in the field. For more information, contact Betty Hopper, 223-5973.

Management Science Group, managed by Bob Levasseur (PK3-2/S53, 223-5960), is responsible for all Management Science/Operations Research studies for Customer Services. Some of the key areas include branch office modelling, life cycle costing, repair strategies, and logistics.

3.7 RAMP (RELIABILITY AND MAINTAINABILITY PROGRAM)
Manager: John Shebell (PK3-2/S53, 223-3101)

This group provides consultation and strategic planning for the Customer Services Systems Engineering group. The group's focus is on improving the RAMP profile of Digital's products and systems with an eye on improving the perceived market value of Digital's products and services while reducing total life cycle costs.

The group tries to maintain expertise on what the competition is doing in the RAMP area. They look at the effect of emerging technologies on the service groups, and they coordinate Customer Services role in the product development process.

Contact RAMP Engineering for information about the RAMP features of competitive products. The group should be involved in the strategic planning process from product inception. Also, contact the group whenever a general liaison to Customer Services is needed on Engineering activities which are not product specific.

RAMP Engineering can supply you with evaluations of Digital's competitors, Red and Beige Books and other strategic vehicles, and a liaison to Customer Services as outlined in the previous paragraph.

The group requires early contact and visibility. They need information of all kinds relating to Project Plans, technologies, and Engineering strategies.

4.0 SOFTWARE SERVICES

Manager: Bruno Durr (PK2/S56, 223-5199)

The primary goal of this organization is to satisfy the software services needs of Digital's customers. The organization ensures that software products and services are easy to sell, install, use, and maintain.

Field Software Services – The field consists of three areas: the United States, Europe, and the General International Area (GIA). Field Software Services is responsible for providing four basic services to customers.

- *Warranty Services* are described in the Software Support Categories Addendum to the Software Product Description. These services may include installation of supported Digital software products, answers to written or telephoned inquiries on remedial service and usage questions, and on-site visits when necessary.

- *Sales Support* – Software Services is part of Digital's sales team and as such is responsible for all technical aspects of the sale of software products.

- *Applications/Consulting* services are customer funded. They may take place before the product is delivered, during warranty, or after warranty expiration. These services are intended to give the customer full use of his or her product.

- *Software Product Services* are preventive and remedial maintenance services to keep the system software current and resolve reported software problems.

Product Lines – There are four Software Services Product Lines:

- *Applications and Consulting Services* (PL090) This is a customer funded, one-time applications software and consulting service. These services range from one-time calls, to resident services.

- *Software Maintenance Services* (PL009) The sale of manpower-related preventive and remedial services for Digital's software products.

- *Software Self-Maintenance Services* (PL091) The sale of software updates (and subscriptions to updates) and software information.

- *Software Products* (PL085) Sales of special software products developed to meet a specific marketing requirement in Europe. These products are normally in the form of emulators.

Operations Group – This group provides centralized support to enable the Software Services Organization in the field to meet its objectives. Their principle activity is to furnish technical support. They also coordinate training and administrative activities, and act as an intermediary between Field Software Services and other corporate groups.

The Operations Group is made up of the following groups:

- The *Technical Support Group*, managed by Dave Backman (AK, 246-2278), provides backup support to the field, cooperates with other corporate groups in giving Software Performance Reports (SPRs) to customers, performs training functions, and develops support tools.

- The *Training Group*, managed by Tom Fleischmann (PK2/S44, 223-8702), identifies, develops, and implements training for the Software Services Organization worldwide in conjunction with Educational Services.

- The *Management Information Services Group* (MISG), managed by Bill McCullough (PK3-2/S29, 223-4876), designs, develops, and runs internal programs which aid Software Services in managing, controlling, and evaluating its operations.

- The *Administration Services Group*, managed by Angela Cossette (PK2/E49, 223-4511), supplies administrative support services for employees and central services for customers. The group maintains Software Performance Reports (SPRs), Software Product Descriptions (SPDs), coordinates the field testing of new products, and publishes dispatches, bulletins, and reviews needed to meet warranty and maintenance commitments to customers.

Contact the organization whenever you have questions about the field testing of software, Software Performance Reports, Software Product Descriptions, or software support problems.

The organization needs from you high quality software products to minimize increasing support costs. Products, ideally, should be easy to sell, install, use, and maintain.

The organization also asks your cooperation in providing prompt Software Performance Report replies to customers. They also need assistance in establishing effective field testing of new and revised software products. Furthermore, Software Services needs technical assistance in the support of software to meet their goal of having satisfied customers. They also need accurate information to publish Software Product Descriptions.

For more information, see the Software Services Reference Guide (available from Carol Bibbins, 223-8766).

SECTION 10

REFERENCES AND RESOURCES

This section references information about Digital's publications, committees, and services. Listed here is information that can help you obtain copies of promotional materials, hardware and training materials, software documentation, and financial information. Additionally, some company policies, standards, and specifications are described briefly. For your information, lists of company newsletters, library publications, and current committees are included. Finally, this section highlights resources available in the Digital Telephone Directory as well as what you should know about company transportation and employee training and education.

1.0 PRINTING AND CIRCULATION SERVICES (P&CS)

This organization warehouses and fills orders for sales and service promotional materials, training manuals, hardware manuals, procedure and reference manuals, software product descriptions, and blank standard and custom forms.

To help you locate and order printed materials, Printing and Circulation Services issues three indexes: Sales Promotion Publications Index, Technical Documentation Index, and Forms Index. Each index listing includes a title of the publication, a catalogue number, and in some cases, a restriction code or releasing authority.

To order any or all of the indexes, submit your request in writing. Include your name, badge number, cost center, and location. Mail to Printing and Circulation Services, Mailing List Maintenance, NR2-2/M15. State which index(es) you wish to receive.

To order printed materials from the indexes, obtain a Request for Literature form (found in the P&CS Indexes). Fill out the form indicating quantity needed, catalogue number, title, and date required. Mail phis form to Printing and Circulation Services, Request for Literature, NR2-2/M15. Telephone orders and incomplete requests cannot be processed.

2.0 COMPANY POLICIES, STANDARDS, AND SPECIFICATIONS

DEC Standard 001
This document is available from Standards and Methods Information and Control, ML5-2/E56, 223-5924. In three sections it describes the corporate policy for DEC Standards and provides general information about the management and administration of the DEC Standards system. It describes the procedures required to create new standards and make changes to existing ones. It also describes the format and minimum content requirements for DEC Standards.

DEC Standard Index
This index is published quarterly in the Engineering Newsletter and is also available from Standards and Methods Information and Control, ML5-2/E56, 223-5924. DEC Standards in the index are arranged by number and areas of interest. The index contains abstracts, responsible persons, departments, revision level, and date of revision.

Personnel Policies and Procedures
This manual is available from Andy Kurtz, PK3-1/C19, 223-4229. It contains corporate personnel notices and administrative procedures. Distributed to all cost center managers on request.

Corporate Policy Memorandums
This document is available from Win Hindle, ML10-2/A53, 223-2276. It contains general information and guidelines regarding company policy. Distribution is restricted.

Software Development Policies and Procedures
This manual is available from Gladys Pannell, ML12-3/E80, 223-6720. It contains policies governing the process of developing software products, including plans, specifications, and a description of the phase review process. Available by subscription.

Software Standards Notebook
This document is available from Pat White, ML12-3/E51, 223-4094. It contains all approved corporate software-related and software documentation standards, including a description of the standards process and a complete listing of DEC Standards. Distributed by subscription and updated pariodically.

Software and Industry Standards Summary
This document is available from Pat White, ML12-3/E51, 223-4094. It contains brief abstracts of Digital and industry standards, and probable schedules for pending standards. It gives the company contact for each standard but does not include standards relating to drafting, micrographics, or corporate processes. Published twice a year, it is available on request.

Index of Engineering Specifications
This index is available from Jody Batsford, ML5-2/E56, 223-9475. This is the Master Index of 7665 series Engineering Specifications #A-SP-7665000-0-0 through #A-SP-7665999-0-0. The index and individual specifications are available on microfiche in the documentation departments of every plant. It includes titles, specification numbers, and rev numbers.

3.0 RAINBOW BOOKS

Rainbow Books are reports produced and distributed by various organizations in Engineering and Manufacturing. The following list identifies these reports by color and title, distribution, and responsible contacts.

Red Book
Management Summary and Justification of Central Engineering Development Budget.
This book is produced in the Fall and Spring of each year. Distribution is limited and strictly controlled. Available from Sy Lyle, ML12-1/T39, 223-7311.

Beige Books
Product Strategy by Product Class and Family.
There is a Beige Book prepared for Computer Systems Development, Software Engineering, Technical Operations, Technical Director, LSI Engineering, Storage Systems Development, Mid-Range and Distributed Systems, Large Systems Product Development, and the Corporate Research Group. Distribution is limited and strictly controlled. Available from Sy Lyle, ML12-1/T39, 223-7311.

Blue Book
Manufacturing Management Report.
Produced monthly, the Blue Book has limited distribution. Sections of the Blue Book referencing company plans of a highly confidential nature are strictly controlled. Available from Pete Bagg, ML1-4/P69, 223-8533.

Green Book
Manufacturing Cost Reports.
Produced monthly, the Green Book is distributed to Product Line group managers, controllers, and corporate management. Selected pages are distributed to plant management. Available from John O'Brien, ML1-5/F31, 223-3197.

Pink Book
Option and Basic System Actual Cost Report.
Distributed quarterly, the Pink Book is strictly controlled and confidential. Available from Ralph Lent, ML1-5/F31, 223-3841.

Brown Book
Product Line and Area Financial Statements.
Produced monthly, the Brown Book has limited distribution and is strictly controlled. Available from Walter Clancy, MS/F11, 223-4668.

Yellow Book
Engineering and Products Yellow Book – Detailed Description of the Status of Engineering Projects.
Produced monthly, the Yellow Book has limited distribution and is strictly controlled. Available from Susan St. Croix, ML3-3/B91, 223-2196,

Black Book
Management Overview of Process Strategies, Planning, and Budgeting.
Produced periodically and available from Arun Dube, ML1-5/E30, 223-7060.

Slate Books
Strategies by Process and Function, Planning and Budgeting.
Produced periodically by managers of Manufacturing processes and functions. The books have open distribution. Contact Jim Melvin, AC/E48, 223-2310, for more information.

Polka Dot Book
Manufacturing's Report on New Products Being Introduced into Manufacturing. Produced quarterly, the Polka Dot Book has limited distribution and is strictly controlled. Available from Joe St. Amour, ML1-5/E29, 223-2596.

4.0 FINANCIAL INFORMATION

Chart of Accounts
This document is available from Suzanne Rose, MS/F33, 223-4143. It contains general ledger accounts, cost center numbers, discrete project numbers, product line numbers, sales activity codes, and expense activity codes. Copies are usually sent to all cost center managers.

DEC Standard Price List and Addenda
This document is available from Valerie Corbin, PK3-1/S18, 223-4936. It is published quarterly on the first Monday of each fiscal quarter. Addenda are published monthly. Distributed on request.

Standard Cost Listing
This document is available from John Zinn, ML1-5/F31, 223-7859. Produced by Manufacturing Financial Control, this document is distributed monthly on microfiche. It lists parts on the Master Parts File, with a description, costs, and the latest ECO.

5.0 GENERAL REPORTS AND DOCUMENTS

Bill of Material
This is a list of parts that go into another part or option. For a packaged system, this is a list of options to be ordered and assembled in Final Assembly and Test. The document is used by Manufacturing Materials and Planning. Copies available from Frank Corbett, ML1-4/P69, 223-8535, (see also the Engineering Product Library System, Section 5, paragraph 3.5.6.2, for more general Bills of Material).

Component Index Books
This is a guide to purchased components in use at Digital. Primarily a design engineering tool, it is available in hard copy and microfiche. It is issued in three separate volumes: multi-class, 90 class, and FCD (Functional Code Descripter). Available from Ginger Pierlo, ML5-2/P67, 223-2642.

DECUS Program Library
The DECUS Program Library, available to both Digital and outside DECUS members, is a clearing house for user programs. It provides a reproduction and distribution service only. No programming assistance can be given. If a program does not work as stated, the problem should be documentated and sent to DECUS. It will be forwarded to the author for comment. If the program is deemed inoperable as stated by the author's documentation, the program will be removed from the library.

The description and availability of the software products described in the foregoing catalogues are subject to change without notice. Distribution shall be in accordance with the Standard Policy for each software product.

DECUS Program Library Catalogues

- PDP-11
- PDP-8, FOCAL 8, BASIC 8
- DEC 10/20

DECUS catalogues are published twice a year. Updates are published periodically as well as becoming part of newly published catalogues. The following is a list of DECUS Program Library contacts:

- Accounting or Pricing Information - Leslie Dube, MR2-3/E55, 231-4135
- Program Orders and Information - Cheryl Barber, MR2-3/E55, 231-4272
- New or Proposed Library Submissions - Donna Portosa, MR2-3/E55, 231-4178

Document Control File (DCF)
This is an automated file with Engineering document number, description, revision, ECO pending, and site location data. For access, contact Frank Alla, ML4-2/E90, 223-9878.

Document Retrieval System
Master List contains project plans, standards, important memos, and other software-related documents and is available on a restricted basis. Master List also tells how to use the system. Available from Rose Dunnigan, ML11-2/B39, 223-4953.

Field Service Summary of Failure Rates
This document contains a summary of componenp failures sorted by hardware type, device, and failure description. Also, it summarizes failures by modules and systems. Distributed on a restricted basis monthly. Contact Ron LeBlanc, PK3-2/S53, 223-3088.

Field Service Installation Quality Report
This document is distributed monthly to all Quality Control managers. Contact Bob Schaller, PK3-2/S17, 223-4205.

Market Data Center Memos
This index of new reports, recent findings, abstracts, and financial marketing reports is published monthly. Contact Jerry Todd, PK3-1/S52, 223-3631.

Minicomputer, LCG, VAX, and KS10 Libraries
Microfiche compilations of all Digital documentation useful to Field Service engineers. Library contains hardware manuals, diagnostics, and all maintenance-related documentation. Index to fiche is included. Available from Mary Antonelli, 249-2019, Bedford.

Option Module List
This document is available from June Payne, ML3-3/H14, 223-2912. It contains designations of all equipment which has been, is, or will be available for sale by Digital. The list is sorted by model number, and gives the responsibility for and status of each model number (including CSS and Software items) as well as a description and, generically, where it is used. Two versions of the list are published. Both are in hard copy and microfiche.

Version 1 is updated quarterly on hard copy and monthly on microfiche. Status 0 (cancelled), status 1 (unannounced), and status 7 (really obsolete) entries are not shown. To be added to the distribution list, contact Jane Hanley (223-6493) or Kathy Murray (223-2886).

Version 2 is updated monthly and is a complete listing of options and modules. The list is confidential and is distributed on a need-to-know basis. For a copy, contact Dick Best (223-2273) or June Payne (223-2912).

A *Computer Special Systems* subset of all options and modules is also available on a need-to-know basis. Copies are available from Carleton Davenport (264-6654, NP).

An *Option Module Software Subset List* is also available from Jeannette Sutton (ML11-3/E52, 223-4245). This list contains option numbers, responsible person, design engineer, product manager, manufacturing representative, status code, product category, description, and what it is used on. Distribution is monthly and restricted to a need-to-know basis.

Purchase Specification Microfiche
This data base contains purchase specifications on those components purchased by Digital. It is available to the user at the Purchase Specification Department (ML5-2/P67) or through distribution by contacting Carl Bull, 223-5124.

Reliability Reports, Mean-Time-To-Repair Options, Summary Reports This report contains detailed information from the field on systems and options. Available on request from Dori Cohen, PK3-2/S53, 223-2440.

Revcon Listing
This is the current list for all shippable modules, subassemblies, power supplies, cables, and logics. Available on microfiche through a valid discrete project charge number. Distribution is open. Contact John Holt, ML4-2/E90, 223-2455.

System Software Information
Distributed to Field Service, Sales, and Software personnel, this manual is a reference guide for support information concerning Digital software products. It supplements information found in the software product descriptions. The manual is available from Gladys Pannell, ML12-3/E80, 223-6720.

VSMF (Visual Search Microfilm)
This is a subscription service containing vendor catalogue data on many products and technologies supplied by U.S. manufacturers. It is updated monthly and is available for viewing at the Purchase Specification Department. Contact Helen Monsen, ML5-2/P67, 223-2642.

6.0 COMPANY NEWSLETTERS

The list below represents only some of the newsletters published by Digital organizations. The intent has been to list those newsletters pertinent to Engineering personnel. To receive a newsletter, contact the corresponding responsible person.

Newsletters	*Contact/DTN*
Access (Manufacturing, Distribution & Control)	Sue Vezina, 264-5437
Added Value (Technical OEM)	Bob Niro, 223-9696
CAD Newsletper	Liz Van Twuyver, 223-8757
Central Commercial Engineering News	Jim Harnedy, 264-5680
CLAS Software Dispatch	Anne Bulger, 223-5886
Component Engineering Newsletter	Maryann Reardon, 223-4797
Consultant's Reference Guide Newsletter (New Products Marketing)	Roger Handy, 223-3550
Decminster (Westminster Manufacturing)	Beth Newell, 241-2018
DECsystem-10 Bulletin and Dispatch	Anne Bulger, 223-5886
DECSYSTEM-20 Bulletin and Dispatch	Anne Bulger, 223-5886

Newsletter (Cont'd)	*Contact/DTN*
DECUScope	Cheryl Lickteig, 231-4131
Digital Software News	Anne Bulger, 223-5886
Digital This Week	Available at all facilities
DMS-11 Software Dispatch	Anne Bulger, 223-5886
Educational Computer Systems Newsletter	Barbara Morin, 231-4337
Engineering Newsletter	June Payne, 223-2886
Feedback (Corporate Information Services)	Marian Anderson, 223-3867
Friday Package (Laboratory Data Products)	Jim Andrews, 264-5851
IAS Software Dispatch	Anne Bulger, 223-5886
Large Buffer (Software DEC 10/20)	Marie Ford, 231-6374
Large Computer Group News	Arlene Lysik, 231-6352
Mainely DEC (Maine Manufacturing)	Jack Gallant, 271-2203
Market Data Center Memo	Jerry Tood, 223-3631
Microware Newsletter	Bill Vaillancourt, 223-7108
MINC-11 Software Dispatch	Anne Bulger, 223-5886
Mountain Matter (Colorado Springs Manufacturing)	Dot Nelson, 522-2303
Package Engineering Newsletter	Bill Roberts, 223-3177
People Paper (West Springfield Manufacturing)	Carolyn Malloy, 244-2145
Personnel Newsletter	Andy Kurtz, 223-4229
Please Post - Library Newsletter	Corporate Library, 223-5821
Purchase Specification Biweekly Bulletin	Pat Davan, 223-2275
Quality Newsletter (Corporate Quality Assurance)	Darby Checketts, 223-4414
Que Pasa? (Albuquerque Manufacturing)	Joyce Cardin, (505) 345-3311

Newsletter (Cont'd)	*Contact/DTN*
RSMX Software Dispatch	Anne Bulger, 223-5886
RSTS-E Software Dispatch	Anne Bulger, 223-5886
RT-11 Software Dispatch	Anne Bulger, 223-5886
Salem System Highlights (New Salem Manufacturing)	Sue Brander, 261-2455
Secretarial Views	Maureen Cybolski, 223-9428
Sights and Sounds (Woburn Manufacturing)	Michelle Barrett, 236-2586
Small Buffer (Software PDP-8/11)	Anne Bulger, 233-5886
Software Engineering News	Maddie Anastas, 223-2339
Software Tools Development and Methods	Steve Gutz, 223-4342
Sun DEC (Phoenix Manufacturing)	Carol Monyer, (602) 993-5111
The Minute Man Newsletter (Software Product Service)	Rosemary Eash, 223-8309
The Readout (Westfield Manufacturing)	Becky Tayler, 242-2700
U.S. Area News (U.S. Field Personnel)	Lea LaFlamme, 223-8446
VAX Newsletter	Pat Ward, 223-6600
What's Up DEC (Burlington, Vermont Manufacturing)	Prudy Sullivan, 266-2244

7.0 LIBRARY PUBLICATIONS

Accessions List
This is a monthly publication that includes a select list of new books, reports, proceedings, magazines, and cassettes received in the library. This list is available by subscription. Contact Virginia White, ML4-3/A20, 223-6105.

Periodicals in the Library
This is a semiannual publication listing all magazine titles held in the library collection. All serials, i.e., journals, periodicals, and magazines are listed alphabetically by title. Information also includes the size and format of holdings. Serials on order are also listed. A subject breakdown of the periodicals is provided in a separate section at the end of the list. Available from Helen MacFadyen, ML4-3/A20, 223-6232.

Audio/Visual Course Listing
This is a periodic publication listing by subject all audio and video cassette courses available in the library. Annotations include length of tape, course objectives, and other relevant data to help you determine the benefits of taking a course. Available on request, or distribution by contacting Betsy Cane, ML4-3/A20, 223-6233.

Library Link Lists
These are bibliographic compilations that reflect the library's collections on specific subjects, e.g., finance, word processing, quality of work life, women in management, etc. Publication of these lists is irregular. Special topical requests can be researched. Contact the Reference Department, ML4-3/A20, 223-6231.

Microfiche Edition of the Card Catalogue
This is a quarterly compilation of all items in the library's collection. Available on request, or by distribution by contacting Virginia White, ML4-3/A20, 223-6105.

8.0 DIGITAL COMMITTEES

Committees	*Contact/DTN*
Advertising Board of Directors	Gus Ashton, 223-3726
Aviation	George Chamberlain, 223-5305
CAD Board of Directors	Bob Kusik, 223-2320
Controls Systems	Jim Harnedy, 264-5680
Contracts Review Board	Steve Brace, 223-4491
Contributions	George Chamberlain, 223-5305
Career Development	Mary Beatrice, 223-9694
Corporate Information Services Standards	Norm Horne, 223-5075
Critical Materials	Jack Batten, 223-6727
Cross Products	Dan Goor, 223-2895
DEC BASIC Standard	Tom Harris, 264-6779
DEC COBOL Standard	Jeff Rudy, 264-6680
DEC EDITING Standard	Bob McKenzie, 264-6681
DEC Standard 012 Steering	Joe Kurta, 223-8895
Drafting Communications	John Carter, 231-4245
Engineering	Allan Kent, 223-8701
Engineering Board of Directors	Andy Knowles, 223-2233
Engineering Review Board	John Murray, 223-5118
Environmental	Ed Spuler, 264-6720
Field Management	Ted Johnson, 223-5942
Finance/Administration	Al Bertocchi, 223-5311
Investment	George Chamberlain, 223-5305
Language Standards	Jeff Rudy, 264-6680
Low End Research and Development	Dick Loveland, 223-7107
Major Contracts Review	Ed Finn, 223-8300
Manufacturing	Joe St. Amour, 223-2596
Manufacturing/Engineering	John Holman, 223-5533
Marketing	Andy Knowles, 223-2233
Marketing Task Force	Glenn Reyer, 264-5974
Office of Development	Gordon Bell, 223-2236
Operations	Win Hindle, 223-2338
Order Administration	Lou Reagan, 223-6693
Order Administration Managers	Les Norman, 231-5811

Committees	*Contact/DTN*
Order Administration Technical	Marty Sack, 223-6631
PASCAL Internal Standards	Leslie Klein, 247-2653
Patents	Tom Siekman, 223-4422
Personnel	Shell Davis, 223-2838
Personnel Policy Development	Andy Kurtz, 223-4229
Personnel Systems Management	Romney Biddulph, 223-4166
Personnel Systems Working	Jeff Singer, 223-6557
Pricing Policy	Andy Knowles, 223-2233
Printed Circuit Communications	Joe Kurta, 223-8895
Producibility	George Ross 232-2596
Product Safety	Ron Minezzi, 223-3122
Research and Advanced Development	Dan Goor, 223-2895
Software Performance	Dave Kosko, 247-2344
VAX Architecture	Dileep Bhandarkar, 247-2021
Wire Wrap Communications	Joe Kurta, 223-8895
Workmanship	Norm Green, 242-2466
1990s (Manufacturing)	Bob Hopely, 223-3864
1990s (Space)	Al Bertocchi, 223-5311

9.0 DIGITAL TELEPHONE DIRECTORY

The Digital Telephone Directory contains a plethora of information about the many resources available to you at Digital. The directory is available to all employees at Office Supplies Stockrooms throughout Digital's facilities. Your department secretary can direct you to the proper source or get one for you.

The following information and procedures are contained in the directory:

- North American Customer Assistance
  - Extension and location
  - Important numbers to know within Digital facilities in Massachusetts
- How to update your listing
- Metropolitan Boston Telephone Service
- Dialing instructions for
  - Digital Telephone Network (DTN)
  - WATS lines
  - Metropolitan Boston
  - Long distance
  - International calls
  - Local calls
- Special Telephone Services
  - Credit Card calls
  - Telephone service requests
  - Conference calls
  - Transferring calls
- Corporate Message Services (RCS)
- International Suggested Calling Times
- World Holidays
- Domestic Suggested Calling Times

Separate instructions for each facility's edition

- Mail Services
  - Post Office
  - Interoffice
  - Field Office
  - Mail arrival/departure schedules
  - Special Services
  - General Information
- Location Codes
- Order Processing Groups
- Personnel Listing
- Departmental Listing
- Domestic Office Listing
- Canadian Office Listing
- European Listing
- General International Area Listing
- International Distributors
- Emergency Numbers

10.0 TRANSPORTATION

Interplant
Aircraft and van transportation services are available to and from the various Digital facilities in the New England area. Van schedules are posted on bulletin boards throughout facilities. Aircraft schedules are posted at the entrances to the facilities and paper fliers are available from receptionists or security guards. Scheduled freight flights (allowing up to 2 passengers) leave Boston every Saturday afternoon for Dublin, Ireland and Frankfurt, Germany. Contact Parker Street travel at 223-5522 for reservations and information.

Commuter
Digital encourages employees to form car pools and van pools to travel to and from work. In fact, Digital will provide a commuter van to anyone who can round up at least 10 riders including a driver. If you are interested in joining a car pool or a van pool, or starting either one yourself, contact the Commuter Transportation Department, MS/B88, 223-8484.

11.0 EMPLOYEE EDUCATION AND TRAINING

Employee education exists to improve employee job performance by delivering quality education products in a timely, cost-effective manner. General training is open to any employee on a first-come, first-serve basis. The organization offers total programs for groups such as Software Services, Corporate Information Systems, and Field Service. They also provide programs for specific job functions such as Clerical Skills, Word Processing Training, Software Training, Hardware Training, and a variety of other programs.

Courses are scheduled at Bedford and other Digital facilities. On-site courses are available by arrangement. Self-paced instruction and audio-visual courses are offered at six Individual Learning Centers – Maynard, Bedford, Princeton, New Jersey, Rolling Meadows, and Los Angeles.

For programmers and their managers, eight generic courses in the audio-visual format are continuously offered at the six Individual Learning Centers. Lecture/lab software courses cover VAX/VMS, RSX, RSTS, DEC 10/20, BLISS language, Standard Editor, etc.

New and current users of Word Processors can obtain introductory, basic, intermediate, and advanced courses. Users of DEC 10/20 hardware and software can learn the hardware, software, and overall capabilities of the systems as well as specific skills like text formatting and editing. In Communications, courses are offered on the Internal Message Switching system (RCS) and the Electronic Mail System (EMS).

The *Employee Education Course Schedule*, published quarterly, details offerings at U.S. locations, announces new courses, and contains information about current educational resources.

The *Employee Education Catalogue* is published yearly and contains a complete description of course contents, prerequisites, and objectives. Both publications are automatically sent to all U.S. cost center managers, personnel representatives, and personnel service administrators.

To receive copies of these publications, or to make arrangements for on-site courses, contact Employee Education Marketing, BU/E06, 249-2300.

To register for courses, or to arrange for housing and transportation while in training, contact the Employee Education Registrar, BU/C2, 249-2675.

APPENDIX I

How To Protect Digital's Intellectual Property

Unquestionably, Digital is a high technology company and a leader in the computer industry. In order to maintain this leadership Digital must continue to develop and protect its various forms of proprietary information and knowledge. Such information and knowledge can take the form of ideas embodied in products (both hardware and software), processes to build, assemble, or test those products, business information concerning sales and marketing figures, published information contained in books, manuals, engineering drawings, and other internal information such as new product planning strategies and developments.

Each piece of such information is a valuable asset. Not only can it give Digital a competitive advantage in the marketplace, it could be very valuable data to our competitors. It is, therefore, of the utmost importance that each employee, and in particular those employees dealing with research or product development, be aware that Digital's knowledge and know-how must be properly safeguarded from competitors.

Digital protects its proprietary information, often referred to as intellectual property, by using various methods provided by law. There are four principal areas of intellectual property law to protect this information, namely, patents, trademarks, copyrights, and trade secrets. Several staff patent attorneys form part of Digital's Law Department and are responsible for servicing Digital's Engineering groups, particularly with respect to matters involving intellectual property. When issues are raised involving patents, trademarks, copyrights, and trade secrets, the patent attorney responsible for the particular engineering group should be contacted. If a potential problem is recognized involving Digital information and the patent attorney is contacted, measures can be taken to adequately protect Digital's information.

The following is a brief overview highlighting the basic concepts involved in the law of intellectual property. It is intended to aid you in spotting these intellectual property issues.

Patents

Congress has passed laws to protect idea information. One form of idea information, inventions, is protected by patents. The grant of a patent is in effect a contract between the government and an inventor. In exchange for a public disclosure of an invention, the government grants the inventor the right to exclude others in this country from making, using, and selling the invention for 17 years. Similar provisions apply in other countries.

An engineer. in the course of his or her work, may develop an "invention" (a new and useful mechanism, article, or method) which has a degree of novelty or uniqueness greater than what a skilled technician or engineer would develop in performing his or her day-to-day work.

It is important for you to continually review your work to determine whether it qualifies as an invention. You are not expected to know whether the invention is patentable or not. The cognizant patent attorney will determine this. However, you should be able to identify those things which contain some ingenuity and which, to your knowledge, were not previously known or invented by someone else. Once it has been established that an invention has been developed, the invention should be disclosed to the Law Department.

To aid in the protection of inventions incorporated in our products, Digital has established a Patent Committee responsible for determining whether or not to file patent applications on inventions made by Digital personnel. The committee has formulated a basic patent policy under which Digital will attempt to find (and file patent applications for) at least one patentable invention in each product we expect to sell in volume. A patent on our important products may range from protecting a feature in the product to the entire architecture of the product. Although the company is more likely to file for patents or inventions actually incorporated in products, Digital will file for patents on other inventions.

Since the grant of a patent is dependent upon the invention meeting certain timing criteria established by the law, all inventions considered for patenting should be brought to the attention of the Law Department before any disclosure outside the company. This would typically be at the prototype or breadboard stage, or before they are incorported into products which are announced, shipped, or described in publications. When an invention disclosure is submitted, the cognizant patent attorney should be advised as to when a public use, sale, or publication of the invention is comtemplated.

Patents obtained by Digital are used to prevent other people from making the product. Digital also licenses the use of its patents so it is paid a royalty for each product made which is covered by the patent. Business factors will determine if we should share the idea by licensing others to use it.

As part of your responsibility to protect new ideas of the company, all personnel performing scientific or technical work in the fields of research, development, and engineering should maintain accurate and complete records of their work. The purpose of maintaining these records is to have a legal record to substantiate the conception of inventions covered by patent applications. The Digital Engineering Notebook system is a valuable tool developed for this purpose. It is the responsibility of Digital technical personnel to maintain Engineering Notebooks, particularly in those instances involving a description of a development that may be patentable (See Section 5, paragraph 3.3.1 of this manual).

Trademarks

A trademark is one or more words, a name, symbol, device, or slogan used by a manufacturer to indicate the source of the goods or services and to distinguish his or her goods and services from those of others. Digital trademarks inform the customer that the product was manufactured by Digital and not someone else. By using a trademark, the owner of the trademark is, in effect, guaranteeing that the trademark product is of the same quality as similarly trademarked products acquired in the past. A trademark is a valuable asset since it provides a highly recognizable link between a customer and the products of the company.

Digital has invested significant amounts of money to associate its trademarks with its products. Marks such as DEC, DECUS, PDP, and the Digital logo are well recognized in the industry and throughout the industrial world. However, trademarks must be protected or they can be lost. It is relatively easy to protect and care for trademarks. The following is a list of some of Digital's more prominent current trademarks:

DEC	**DIBOL**	**PDT**
DECnet	**Digital logo**	**RSTS**
DECsystem-10	**EduSystem**	**RSX**
DECSYSTEM-20	**IAS**	**UNIBUS**
DECUS	**MASSBUS**	**VAX**
DECwriter	**PDP**	**VMS**
		VT

In addition, Digital is constantly coining new marks. Before a new trademark is announced or used, it should be submitted to a patent attorney for a trademark infringement search. This will help us to determine if our new trademark will infringe a trademark already belonging to someone else. By having the trademark search performed early, most legal problems will be found before the company incurs advertising and other costs.

If you encounter any suspicious use of our trademarks by a party outside of Digital, or are planning or participating in the process of choosing a trademark for a new product or service, a patent attorney should be advised.

Copyright

A copyright is a legal right to prevent others from making copies of an author's work provided the work is marked with a proper copyright notice when published. However, a copyright does not protect an author's ideas. It protects only his or her individual expression of those ideas. Ideas expressed in a copyrighted work may be freely used by anyone; however, if someone copies the same expression or modifies it slightly, he or she is not free to use the copy or modification.

Digital information protected by copyright is generally written information. This includes engineering drawings, software, and manuals, but may also be audio visual training courses and other items. Under the law, as long as we put a copyright notice on our publication (a "c" within a circle, year of publication and owner, i.e., © 1979 Digital Equipment Corporation) we have performed the minimum procedures required to obtain copyright protection. DEC Standard 197, Legal Guidelines for Digital Publications, contains requirements for controlling proprietary information and protecting Digital against liability.

At Digital we make a substantial investment in copyrighted information that we publish. We disseminate to our customers a great deal of desired information about our products. At the same time, we use the exclusivity that copyright laws provide to prevent unfair use of our publications. Such unfair use occurs when a similar product is made by a competitor and our copyrighted material is used to describe the similar product.

You should, therefore, be aware that any written works that are expected to be published must have appropriate copyright protection. In the same manner, we must be careful not to violate the copyright of others when we are using their works.

Trade Secrets

In some situations the patent system is not a suitable method of protection for a company's products or processes. A commonly used alternative is to protect the intellectual property as a trade secret.

The law of trade secrets is based on the recognition that it is unjust to permit the misappropriation of technical or commercial know-how which is not in the public domain. The law provides a legal right to prevent, or to recover damages for, an unauthorized disclosure or use of technical or commerical information which is a trade secret. A trade secret may be any confidential formula, pattern, device, or combination of information used in one's business which gives him or her an opportunity to obtain an advantage over competitors who do not know or use it.

A trade secret must be kept "secret" so that it does not become publicly known. A trade secret may be lost by disclosure to others without any limitations. However, the law of trade secrets can be extended into the marketplace by means of contractual arrangements binding the recipient of information to keep it secret.

To adequately prevent a trade secret from becoming publicly known, appropriate internal procedures must be undertaken. These procedures should include as a minimum:

a. Insuring that trade secret information is not provided to customer or vendors except under appropriate agreements;

b. Restricting access to the information to those employees and agents having a "need to know" and informing those employees and agents having access to the information that it is confidential, and;

c. Maintaining general security precautions on the premises, avoiding leaving confidential information in open or uncontrolled areas, restricting access to those locations having sensitive information, etc.

Digital invests a great deal of money and resources to develop its software as well as its hardware products. Because the software products, once on the market, are easily reproduced and copied (the vast number of delivered Digital computers are a ready market for Digital software), it is important that our company legally protect its software products against improper duplication and distribution. Digital has elected to protect its software by both copyright and trade secret theories, with patent protection also attempted in rare cases.

A software license agreement is the legal vehicle under which our customers are licensed to use the trade secrets and copyrights incorporated in our software. Without some form of license agreement, our trade secrets and copyrights in our software products may not be protected when software is provided to customers. For this reason, Digital places extreme importance in providing our software only under an appropriate licensing agreement.

Sometimes during the course of business we may disclose trade secret information that relates to new products before they are announced. If a business decision is made to disclose Digital information, an appropriate non-disclosure agreement must be signed by the recipient. Although the non-disclosure agreement provides some protection, the best protection, of course, is not to disclose the information. Once released by an outside party, whether accidentally or deliberately, Digital confidential information may become public property and subject to unrestricted use. The first approach always should be to try to find a way to conduct transactions without disclosing or transmitting Digital confidential information. This is particularly true for very sensitive and highly proprietary information.

Just as we do not want to disclose our confidential information without restrictions, neither do our customers and vendors. At times we may visit a customer's plant or see what is going on in his or her business, and often the customer may ask us to execute a non-disclosure agreement to protect his or her trade secret information. This is a dangerous situation. We are a large company with a great deal of internal development work. Also, we are exposed to a large number of ideas from our customers. If we internally develop or receive an idea from a third company which resembles information received under a non-disclosure agreement, Digital's legitimate use of the idea could compromise the customer's proprietary information, even if we have not done so.

It is Digital's general policy not to execute non-disclosure agreements. We refuse to receive any trade secret information submitted to us from companies or persons outside of Digital. If for significant business reasons an exception to this policy must be made, then a specific non-disclosure agreement must be negotiated by the Law Department. An appropriate Vice President must sign the agreement on behalf of Digital.

It must be remembered that all Digital employees are obliged to respect the trade secrets of former employers. Thus, no person at Digital is to be given any information which one has reason to believe is a trade secret of a former employer.

The foregoing should aid in the understanding of how and why Digital protects its information. As individual employees, we can each contribute to the protection of Digital information by accepting the following responsibilities:

a. Reviewing our work to determine whether we have developed an invention, maintaining good records concerning the facts related to such inventions, and submitting innovative ideas to the Law Department;

b. Appreciating the fact that all Digital intellectual property, including trademarks and copyrights, are valuable assets and should be properly cared for;

c. Taking appropriate precautions to maintain in confidence Digital's trade secret information so that it is not disclosed outside the company without proper protecting agreements; and

d. Avoiding receipt of confidential information from outside Digital and contacting the Law Department if such receipt is felt to be justified by significant business reasons.

If you have any questions concerning the above, feel free to contact a patent lawyer in the Law Department.

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What features are most useful? __________

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Document Identifier
A-MN-ELENGRS-OM-000
Date: 1-Apr-82
Revision History
Preceding Edition: EB-ENGRS-OM-002

Approved: John E. Holman
John Holman

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PREFACE

As a new employee at Digital, you will feel quickly at home if you have a clear statement of the philosophy and values we believe have made Digital not only an outstanding success in the computer industry, but also a good place to work. Our philosophy has shaped our "style" and the environment in which you will work.

We want the *highest quality products* in the industry. When you ask current or potential computer users, "Who makes the best computer systems?" we want the answer to be "Digital!"

We want *leadership products* in every Digital market – products that do the job for the user better than those available from any other supplier.

The foundation of our success is our knowledge of computer technology; we must always strive to increase that knowledge.

We turn our technology into products through people. We have, and want to continue to have, the *best people* in the industry. We hire the best and we work hard to maintain an environment that allows them to contribute to their fullest potential. The key elements of this environment are:

- **Individual responsibility:** We depend upon our people to use their heads, to reach out for responsibility, to make decisions.

- **Open communication:** There are no barriers to effective communication between people at Digital. Organizational boundaries and titles are, as far as communication is concerned, irrelevant. We believe in total openness on all issues, that issues are best resolved by direct interaction between people, regardless of different organizations or different levels of responsibility.

- **Good ideas:** They come from everywhere. We believe that our managers should encourage and promote the creative ideas that bubble up from people in the organization.

In the last several years, Digital has scored number one as the most *ethical* computer company in the industry. This is no accident. We want to be completely honest and open with our customers. We want them to get their money's worth when they buy from us; we expect to meet all our commitments.

In short, having hired the best people in the industry and provided a rich environment for them, we expect extraordinary performance. Work hard, produce good products, reach beyond the normal requirements of your job, and above all, *use your head*, and both you and Digital will grow and prosper.

We are happy to have you with us. We hope you, too, will enjoy working at Digital.

Larry Portner
Vice President,
Associate Head of Engineering

FOREWORD

The following text is reprinted with permission from "The Unwritten Laws of Engineering" by W.J. King, originally appearing in the May, June, and July 1944 issues of *Mechanical Engineering*. That the article has been reprinted several times during the last 36 years should bear witness to its usefulness. It offers much wisdom to young engineers starting their careers, and to older engineers who know these things perfectly well but who all too often fail to apply them in practice.

IN RELATION TO YOUR WORK

However menial and trivial your early assignments may appear give them your best efforts. Many young engineers feel that the minor chores of a technical project are beneath their dignity and unworthy of their college training. They expect to prove their true worth in some major enterprise. Actually, the spirit and effectiveness with which you tackle your first humble tasks will very likely be carefully watched and may affect your entire career.

Occasionally you will worry unduly about where your job is going to get you – whether it is sufficiently strategic or significant. Of course these are pertinent considerations and you would do well to take stock of them, but by and large it is fundamentally true that if you take care of your present job well, the future will take care of itself. This is particularly so in the case of a large corporation, where executives are constantly searching for competent people to move up into more responsible positions. Success depends so largely upon personality, native ability, and vigorous, intelligent prosecution of any job that it is no exaggeration to say that your ultimate chances are much better if you do a good job on some minor detail than if you do a mediocre job as section head. Furthermore, it is also true that if you do not at first make a good showing on your present job you are not likely to be given the opportunity of trying something else more to your liking.

There is always a premium upon the ability to get things done. This is a quality which may be achieved by various means under different circumstances. Specific aspects will be elaborated in some of the succeeding items. It can probably be reduced, however, to a combination of three basic characteristics:

(a) Energy, which is expressed in initiative to start things and aggressiveness to keep them moving briskly.

(b) Resourcefulness or ingenuity, i.e., the faculty for finding ways to accomplish the desired result, and

(c) Persistence (tenacity), which is the disposition to persevere in spite of difficulties, discouragement, or indifference.

This last quality is sometimes lacking in the make-up of brilliant engineers, to such an extent that their effectiveness is greatly reduced. Such dilettantes are known as "good starters but poor finishers." Or else it will be said of a man (or a woman): "You can't take him too seriously; he'll be all steamed up over an idea today but tomorrow he will have dropped it and started chasing some other rainbow." Bear in mind, therefore, that it may be worth while finishing a job, if it has any merit, just for the sake of finishing it.

In carrying out a project, do not wait for managers, vendors, and others to deliver the goods; go after them and keep after them. This is one of the first things a new engineer has to learn in entering a manufacturing organization. Many novices assume that it is sufficient to place the order and sit back and wait until the goods are delivered. The fact is that most jobs move in direct proportion to the amount of follow-up and expediting that is applied to them. Expediting means planning, investigating, promoting, and facilitating every step of the process. Cultivate the habit of looking immediately for some way around each obstacle encountered, some other recourse or expedient to keep the job rolling without losing momentum. There are ten-to-one differences between individuals in respect to what it takes to stop their drive when they set out to get something done.

On the other hand, the matter is occasionally overdone by overzealous individuals who make themselves obnoxious and antagonize everyone by their offensive browbeating tactics. Be careful about demanding action from another department. Too much insistence and agitation may result in more damage to your personal interests than could ever result from the miscarriage of the technical point involved.

Confirm your instructions and the other person's commitments in writing. Do not assume that the job will be done or bargain kept just because the other person agreed to it. Many people have poor memories, others are too busy, and almost everyone will take the matter a great deal more seriously if he or she sees it in writing. Of course there are exceptions, but at times it pays to mark a third party for a copy of the memo, as a witness.

When sent out on any complaint or other assignment stick with it and see it through to a successful finish. All too often a young engineer from the home office will leave a job half done or poorly done in order to catch a train or keep some other engagement. Wire the boss that you've got to stay over to clean up the job. Neither the boss nor the customer will like it if another person has to be sent out later to finish it up.

Avoid the very appearance of vacillation. One of the gravest indictments of an engineer is to say: "His or her opinion at any time depends merely upon the last person with whom he or she has talked." Refrain from stating an opinion or promoting an undertaking until you have had a reasonable opportunity to obtain and study the facts. Thereafter see it through if at all possible, until fresh evidence makes it folly to persist. Obviously the extremes of bullheadedness and dogmatism should be avoided, but remember that reversed decisions will be held against you.

Don't be timid - speak up - express yourself and promote your ideas. Every young engineer should read Emerson's essay on "Self Reliance." Too many new people seem to think that their job is simply to do what they're told to do, along the lines laid down by the boss. Of course there are times when it is very wise and prudent to keep your mouth shut, but, as a rule, it pays to express your point of view whenever you can contribute something. The quiet mousey individual who says nothing is usually credited with having nothing to say.

It frequently happens in any sort of undertaking that nobody is sure of just how the matter ought to be handled; it's a question of selecting some kind of program with a reasonable chance of success. This is commonly to be observed in engineering meetings. The first person to speak up with a definite and plausible proposal has better than an even chance of carrying the floor, provided only that the scheme is definite and plausible. (The "best" scheme usually cannot be recognized as such in advance.) It also happens that the person who talks most knowingly and confidently about the matter will very often end up with the assignment to carry out the project. If you do not want the job, keep your mouth shut and you'll be overlooked, but you'll also be overlooked when it comes time to assign larger responsibilities.

Before asking for approval of any major action, have a definite plan and program worked out to support it. Executives very generally and very properly will refuse to approve any proposed undertaking that is not well planned and thought through as regards the practical details of its execution. Quite often a young person will propose a project without having worked out the means of accomplishing it, or weighing the actual advantages against the difficulties and costs. This is the difference between a "well-considered" and a "half-baked" scheme.

Strive for conciseness and clarity in oral and written reports. If there is one bane of an executive's existence, it is the person who takes a half hour of rambling discourse to tell what could be said in a sentence of twenty words. There is a curious and widespread tendency among engineers to surround the answer to a simple question with so many preliminaries and commentaries that the answer itself can hardly be discerned. It is so difficult to get a direct answer out of some people that their usefulness is greatly diminished. The tendency is to explain the answer before answering the question. To be sure, very few questions admit of simple answers without qualifications, but the important thing is to state the crux of the matter as succinctly as possible first. On the other hand, there are times when it is very important to add the pertinent background or other relevant facts to illuminate a simple statement. The trick is to convey the maximum of significant information in the minimum time, a valuable asset to anyone.

An excellent guide in this respect may be found in the standard practice of newspapers in printing the news. The headlines give you 90% of the basic facts. If you have the time and interest to read further, the first paragraph will give you most of the important particulars. Succeeding paragraphs simply give details of progressively diminishing significance. To fit an article into available space, the editor simply lops off paragraphs at the rear end, knowing that relatively little of importance will be lost. You can hardly do better than to adopt this method in your own reports, presenting your facts in the order of importance, as if you might be cut off any minute.

Be extremely careful of the accuracy of your statements. This seems almost trite, and yet many engineers lose the confidence of their superiors and associates by habitually guessing when they do not know the answer to a direct question. It is certainly important to be able to answer questions concerning your responsibilities, but a wrong answer is worse than no answer. If you do not know, say so, but also say, "I'll find out right away." If you are not certain, indicate the exact degree of certainty or approximation upon which your answer is based. A reputation for dependability and reliability can be one of your most valuable assets.

This applies, of course, to written matter, calculations, etc., as well as to oral reports. It is definitely bad business to submit a report to the boss for approval without first carefully checking it yourself, and yet formal reports are sometimes turned in full of glaring errors and omissions.

IN RELATION TO THE BOSS

Every manager must know what's going on in his or her bailiwick. This principle is so elementary and fundamental as to be axiomatic. It follows from the very obvious fact that a person cannot possibly manage his or her business successfully unless he or she knows what's going on in it. It applies to minor managers and other individuals charged with specific responsibilities as well as to department heads. No one in his or her right mind will deny the soundness of the principle and yet it is very commonly violated or overlooked. It is cited here because several of the rules which follow are concerned with specific violations of this cardinal requirement.

Do not overlook the fact that you're working for your boss. This sounds simple enough, but some engineers never get it. By all means, you're working for society, the company, the department, your family, and yourself, but primarily you should be working for and through your boss. And your boss is your immediate superior, to whom you report directly. It is not uncommon for young engineers, in their impatient zeal to get things done, to ignore the boss, or attempt to go over or around the boss. Sometimes they move a little faster that way, for a while, but sooner or later they find that such tactics cannot be tolerated in a large organization. Generally speaking, you cannot get by the boss; he or she determines your rating and rates you on your ability to cooperate, among other things. Besides, most of us get more satisfaction out of our jobs when we're able to give the boss our personal loyalty, with the feeling that we're helping him or her to get the main job done.

Be as particular as you can in the selection of your boss. In its effect upon your engineering career, this is second in importance only to the selection of proper parents. In most engineering organizations the influence of the senior engineer, or even the section head, is a major factor in molding the professional character of younger engineers. Long before the days of universities and textbooks, master craftsmen in all the arts absorbed their skills by apprenticeship to master craftsmen. It is very much as in the game of golf; a beginner who constantly plays in company with "duds" is very apt to remain a "dud," too, no matter how faithfully the rules are studied. Whereas even a few rounds with a "pro" will usually improve a novice's game.

But of course, it is not always possible to choose your boss advisedly. What if he or she turns out to be somewhat less than half the person he or she ought to be? There are only two proper alternatives open to you; (a) accept the boss as a representative of a higher authority and execute his or her policies and directives as effectively as possible, or (b) transfer to some other outfit at the first opportunity. A great deal of mischief can be done to the interests of all concerned (including the company) if some other alternative is elected, particularly in the case of younger persons. Consider the damage to the efficiency of a military unit when the privates, disliking the leader, ignore or modify orders to suit their individual notions. To be sure, a business organization is not a military machine, but it is not a mob either.

One of the first things your owe your boss is to keep him or her informed of all significant developments. This is a corollary of the preceeding rules: A manager must know what's going on. The main question is: How much must he or she know – how many of the details? This is always a difficult matter for the new engineer to get straight. Many novices hesitate to bother the boss with too many reports, and it is certainly true that it can be overdone in this direction, but in by far the majority of cases the executive's problem is to extract enough information to be kept adequately posted. For every time the boss has to say, "Don't bother me with so many details," there will be three times he or she will say, "Why doesn't someone tell me these things?" Bear in mind that the boss is constantly called upon to account for, defend, and explain your activities to the "higher-ups," as well as to coordinate these activities into a larger plan. In a nutshell, the rule is therefore to give him or her all the information needed for these two purposes.

Whatever the boss wants done takes top priority. You may think you have more important things to do first, but unless you obtain permission it is usually unwise to put any other project ahead of a specific assignment from your own boss. As a rule, he or she has good reasons for wanting his or her job done *now*, and it is apt to have a great deal more bearing upon your rating than less conspicuous projects which may appear more urgent.

Also, make note of this: If you are instructed to do something and you subsequently decide it isn't worth doing (in view of the data or events) do not just let it die, but inform the boss of your intentions and reasons. Neglect of this point has caused trouble on more than one occasion.

Do not be too anxious to follow the boss's lead. This is another side of the matter covered by the preceding rule. An undue subservience or deference to the department head's wishes is fairly common among young engineers. A person with this kind of psychology may:

1. Plague the boss incessantly for minute directions and approvals.

2. Surrender all initiative and depend upon the boss to do all of his or her basic thinking.

3. Persist in carrying through a design or a program even after new evidence has proved the original plan to be wrong.

This is where an engineering organization differs from an army. In general, the program laid down by the department or section head is tentative, rather than sacred, and is intended to serve only until a better program is proposed and approved.

The rule therefore is to tell your boss what you have done, at reasonable intervals, and ask for approval of any well-considered and properly planned deviations or new projects that you may have conceived.

REGARDING RELATIONS WITH ASSOCIATES AND OUTSIDERS

In all transactions be careful to "deal in" everyone who has a right to be in. It is extremely easy, in a large organization, to overlook the interests of some division or individual who does not happen to be represented, or in mind, when a significant step is taken. Very often the result is that the step has to be retracted or else considerable damage is done. Even when it does no apparent harm, most people do not like to be left out when they have a stake in the matter, and the effect upon morale may be serious.

Of course there will be times when you cannot wait to stand on ceremony and you'll have to go ahead and "damn the torpedoes." But you cannot do it with impunity too often.

Note particularly that in this and the preceding item the chief offénse lies in the invasion of the other person's territory without his or her knowledge and consent. You may find it expedient on occasions to do the other person's job in order to get your own work done, but you should first give the other person a fair chance to deliver the goods or else agree to have you take over. If you must offend in this respect, at least you should realize that you are being offensive.

Be careful about whom you mark for copies of letters, memos, etc., when the interests of other departments are involved. A lot of mischief has been caused by young people broadcasting memoranda containing damaging or embarrassing statements. Of course it is sometimes difficult for a novice to recognize the "dynamite" in such a document but, in general, it is apt to cause trouble if it steps too heavily upon someone's toes or reveals a serious shortcoming on anybody's part. If it has wide distribution or if it concerns manufacturing or customer difficulties, you'd better get the boss to approve it before it goes out unless you're very sure of your ground.

Promises, schedules, and estimates are necessary and important instruments in a well-ordered business. Many engineers fail to realize this, or habitually try to dodge the irksome responsibility for making commitments. You must make promises based upon your own estimates for the part of the job for which you are responsible, together with estimates obtained from contributing departments for their parts. No one should be allowed to avoid the issue by the old formula, "I can't give a promise because it depends upon so many uncertain factors." Consider the "uncertain factors" confronting a department head who must make up a budget for an entire engineering department for a year in advance! Even the most uncertain case can be narrowed down by first asking, "Will it be done in a matter of a few hours or a few months – a few days or a few weeks?" It usually turns out that it cannot be done in less than three weeks and surely will not require more than five, in which case you'd better say four weeks. This allows one week for contingencies and sets you a reasonable bogie under the comfortable figure of five weeks. Both extremes are bad; a good engineer will set schedules which can be met by energetic effort at a pace commensurate with the significance of the job.

As a corollary of the following, you have a right to insist upon having estimates from responsible representatives of other departments. But in accepting promises, or statements of facts, it is frequently important to make sure you are dealing with a qualified representative of the other section. Also bear in mind that when you ignore or discount another person's promises you impugn his or her responsibility and incur the extra liability yourself. Of course this is sometimes necessary, but be sure that you do it advisedly. Ideally, another person's promises should be negotiable instruments, like a personal check, in compiling estimates.

When you are dissatisfied with the services of another section, make your complaint to the individual most directly responsible for the function involved. Complaints made to a person's superiors, over the person's head, engender strong resentments and should be resorted to only when direct appeal fails. In many cases such complaints are made without giving the person a fair chance to correct the grievance, or even before he or she is aware of any dissatisfaction.

This applies particularly to individuals with whom you are accustomed to dealing directly or at close range, or in cases where you know the person to whom the function has been assigned. It is more formal and in some instances possibly more correct to file a complaint with the head of the section or department, and it will no doubt tend to secure prompt results. But there are more than a few individuals who would never forgive you for complaining to their boss without giving them a fair chance to take care of the matter.

In dealing with customers and outsiders remember that you represent the company, ostensibly with full responsibility and authority. You may be only a few months out of college but most outsiders will regard you as a legal, financial, and technical agent of your company in all transactions, so be careful of your commitments.

PURELY PERSONAL CONSIDERATIONS FOR ENGINEERS

About 99% of the emphasis in the training of engineers is placed upon purely technical or formal education. In recent years, however, there has been a rapidly growing appreciation of the importance of "human engineering," not only in respect to relations between management and employees but also as regards the personal effectiveness of the individual worker, technical or otherwise. It should be obvious enough that a highly trained technological expert with a good character and personality is necessarily a better engineer and a great deal more valuable to his or her company than a sociological freak or misfit with the same technical training. This is largely a consequence of the elementary fact that in a normal organization no individual can get very far in accomplishing any worthwhile objectives without the voluntary cooperation of his or her associates. And the quantity and quality of such cooperation is determined by the "personality factor" more than anything else.

This subject of personality and character is, of course, very broad and much has been written and preached about it from social, ethical, and religious points of view. The following "laws" are drawn from the purely practical point of view based upon well-established principles of good engineering practice, or upon consistently repeated experience. As in the preceding sections, the selections are limited to rules which are frequently violated, with unfortunate results, however obvious or bromidic they may appear.

"LAWS" OF CHARACTER AND PERSONALITY

One of the most important personal traits is the ability to get along with all kinds of people. This is rather a comprehensive quality but it defines the prime requisite of personality in any type of industrial organization. No doubt this ability can be achieved by various formulas, although it is probably based mostly upon general, good-natured friendliness, together with fairly consistent observance of the "Golden Rule." The following "do's and don'ts" are more specific elements of such a formula:

1. Cultivate the tendency to appreciate the good qualities, rather than the shortcomings of each individual.

2. Do not give vent to impatience or annoyance on slight provocation. Some offensive individuals seem to develop a striking capacity for becoming annoyed, which they indulge with little or no restraint.

3. Do not harbor grudges after disagreements involving honest differences of opinion. Keep your arguments on an objective basis and leave personalities out as much as possible.

4. Form the habit of considering the feelings and habits of others.

5. Do not become unduly preoccupied with your own selfish interests. It may be natural enough to "look out for Number One first," but when you do your associates will leave the matter entirely in your hands, whereas they will be much readier to defend your interests for you if you characteristically neglect them for unselfish reasons.

This applies particularly to the matter of credit for accomplishments. It is much wiser to give your principal attention to the matter of getting the job done, or to building up your people, than to spend too much time pushing your personal interests ahead of everything else. You need have no fear of being overlooked; about the only way to lose credit for a creditable job is to grab for it too avidly.

6. Make it a rule to help the other fellow when the opportunity rises. Even if you're mean-spirited enough to derive no satisfaction from accommodating others it's a good investment. The business world demands and expects cooperation and teamwork among the members of an organization. It's smarter and pleasanter to give it freely and ungrudgingly, up to the point of unduly neglecting your responsibilities.

7. Be particularly careful to be fair on all occasions. This means a good deal more than just being fair, upon demand. All of us are frequently unfair, unintentionally, simply because we do not habitually view the matter from the other person's point of view, to be sure that his or her interests are fairly protected. For example, when a person fails to carry out an assignment, he or she is sometimes unjustly criticized when the real fault lies with the manager who failed to give him or her the tools to do the job. Whenever you enjoy some natural advantage, or whenever you are in a position to injure someone seriously, it is especially incumbent upon you to "lean over backwards" to be fair and square.

8. Do not take yourself or your work too seriously. A normal healthy sense of humor, under reasonable control, is much more becoming, even to an executive, than a chronically soured dead pan, a perpetually unrelieved air of deadly seriousness, or the pompous solemn dignity of a stuffed owl. It is much better for your blood pressure, and for the morale of the office, to laugh off an awkward situation now and then than to maintain a tense tragic atmosphere of stark disaster whenever matters take an embarrassing turn. To be sure, a serious matter should be taken seriously, and a person should maintain a quiet dignity as a rule, but it does more harm than good to preserve an oppressively heavy and funereal atmosphere around you.

9. Put yourself out just a little to be genuinely cordial in meeting people. True cordiality is, of course, spontaneous and should never be affected, but neither should it be inhibited. We all know people who invariably pass us in the hall or encounter us elsewhere without a shadow of recognition. Whether this be due to inhibition or preoccupation we cannot help feeling that such unsociable chumps would not be missed much if we never saw them again. On the other hand it is difficult to think of anyone who is too cordial, although it can doubtless be overdone like anything else. It appears that most people tend naturally to be sufficiently reserved or else overreserved in this respect.

10. Give other people the benefit of the doubt if you are inclined to suspect their motives, especially when you can afford to do so. Mutual distrust and suspicion breed a great deal of absolutely unnecessary friction and trouble, frequently of a very serious nature. This is a very common phenomenon that can be observed among all classes and types of people, in international as well as local affairs. It is derived chiefly from misunderstandings, pure ignorance, or from an ungenerous tendency to assume that a person is guilty until proved innocent. No doubt the latter assumption is the "safer" bet, but it is also true that if you treat others as depraved scoundrels, they will usually treat you likewise, and they will probably try to live down to what is expected of them.

Regard your personal integrity as one of your most important assets. In the long pull there is hardly anything more important to you than your own self-respect and this alone should provide ample incentive to maintain the highest standard of ethics of which you are capable. But, apart from all considerations of ethics and morals, there are perfectly sound hardheaded business reasons for conscientiously guarding the integrity of your character.

One of the most striking phenomena of an engineering office is the transparency of character among the members of any group who have been associated for any length of time. In a surprisingly short period each individual is recognized, appraised, and catalogued for exactly what he or she is, with far greater accuracy than that individual usually realizes. This is true to such a degree that it makes people appear downright ludicrous when they assume a pose or otherwise try to convince us that they are something better than they are. As Emerson puts it: "What you are speaks so loud I cannot hear what you say." In fact, it frequently happens that people are much better known and understood by their associates, collectively, than they know and understand themselves.

Therefore, it behooves you as an engineer to let your personal conduct, overtly and covertly, represent your conception of the very best practical standard of professional ethics, by which you are willing to let the world judge and rate you.

Moreover, it is morally healthy and tends to create a better atmosphere, if you will credit the other fellow with similar ethical standards, even though you may be imposed upon occassionally. The obsessing and overpowering fear of being cheated is the common charactersitic of second- and third-rate personalities. This sort of psychology sometimes leads a person to assume an extremely "cagey" sophisticated attitude crediting him or herself with being impressively clever when he or she is simply taking advantage of his or her more considerate and fairminded associates. On the other hand a substantial majority of top-flight executives are scrupulously fair, square, and straightforward in their dealings with all parties. In fact most of them are where they are largely because of this characteristic, which is one of the prime requisites of first-rate leadership.

The priceless and inevitable reward for uncompromising integrity is confidence, the confidence of associates, subordinates, and "outsiders." Confidence is such an invaluable business asset that even a moderate amount of it will easily outweigh any temporary advantage that might be gained by sharp practices.

Integrity of character is closely associated with sincerity, which is another extremely important quality. Obvious and marked sincerity is frequently a source of exceptional strength and influence in certain individuals, particularly in the case of speakers. Abraham Lincoln is a classic example. In any individual, sincerity is always appreciated, and insincerity is quickly detected and discounted.

In order to avoid any misunderstanding, it should be granted here that the average person, and certainly the average engineer, is by no means a low dishonest scoundrel. In fact, the average person would violently protest any questioning of his or her essential honesty and decency, perhaps fairly enough. But there is no premium upon this kind of common garden variety of honesty, which is always ready to compromise in a pinch. The average person will go off the gold standard or compromise with any sort of expediency whenever it becomes moderately uncomfortable to live up to his or her obligations. This is hardly what is meant by "integrity," and it is certainly difficult to base even a moderate degree of confidence upon the guarantee that you will not be cheated unless the going gets rough.

Finally, it should be observed that the various principles which have been expounded, like those of the arts and sciences, must be assiduously applied and developed in practice if they are to become really effective assets. It is much easier to recognize the validity of these "laws" than it is to apply them consistently. The important thing here is to select, in so far as possible, a favorable atmosphere for the development of these professional skills. This is undoubtedly one of the major advantages of employment in a large engineering organization. Perhaps, even more important, as previously mentioned, is the selection of your boss, particularly during those first few years that constitute your engineering apprenticeship. No amount of precept is as effective as the proper kind of example. Unfortunately, there is not nearly enough of this kind of example to go around, and in any event it will behoove you to study the "rules of the game" to develop your own set of principles to guide you in your professional practice.

CHAPTER 1

CORPORATE OVERVIEW

1 SCOPE

Orientation means to familiarize with or adjust to a new situation; it also means to align or position with respect to a specific direction or reference system. Chapter 1 helps you become familiar with Digital Equipment Corporation in four ways. First, Ken Olsen, founder and president of Digital, relates Digital's own brand of philosophic autonomy in the areas of communication, compromise, and cooperation. Second, a short history of the company's achievements is provided. Next, "Digital Philosophy" provides you with positive, growth-producing values inherent to the operation of the company. Finally, Digital's management style and structure are broadly outlined. These topics in Chapter 1 provide you with a perspective with which you may meld your personal goals with those of the corporation to grow and prosper.

Note

All domestic telephone numbers in this manual are on the Digital Telephone Network (DTN), accessible only from inside a Digital facility. See your Digital Telephone Directory or local operator for external exchange codes.

2 INTRODUCTION - KEN OLSEN

Before you select specific sections to read that may be of immediate interest to you, take a few minutes to read the following excerpts from a speech given by Ken Olsen to an engineering group.

> "Don't communicate with neighbors in your community about company matters; there is just too much information about what we do at Digital that reaches people outside the corporation. Sometimes we don't fully appreciate the importance of keeping our mouth shut because any one thing doesn't look all that significant. But altogether, things are really important. Any time we, as a company are so open and talk about company matters, we invest heavily in communication.

"Everything is a compromise and we ought to consider every decision we make as a meaningful compromise. The whole art of engineering is compromise. Therefore, engineers of all people should be best at compromising. Often, however, they have the worst time in making compromises. You can't build a bridge, or an airplane, or a computer that's absolutely safe in every alternative. It would take forever, cost an infinite amount of money, and there wouldn't be enough weight left for cars on the bridge, you couldn't get off the ground in the airplane, and you couldn't meet your schedule.

"There is no absolute safety. We're professionals, we can't get away with saying 'I will go all the way, one way and be safe.' We must find the best compromise and then live with the ensuing criticisms. We just learn by our mistakes and do better. That's what we're paid for in our profession. There is a list of things in which we must compromise and identifying them, I think, will help us face the issue.

"The first area of compromise is in new technology. The only time we claim that we've ever been ahead of technology is the day we opened our doors and we've been behind ever since. There are a number of reasons for this. When we started, we had a handful of technology. After that we had to live with our previous product and with our customers who dictated what they wanted. In general, they didn't care about technology. They wanted the products to continue, they had problems to solve and that is what they were interested in. Compromises come because in the long run they use technology that gives the best product, the best solution to problems, the lowest price, and the best reliability. We must always face that.

"A few years ago, the world was promising great things in integrated circuits. The professors at MIT were promising then what we can just do today and the world hated us because we said it wasn't ready yet. We were the last ones to use integrated circuits, and then we were 6 months early! The argument that showed we were right said that we paid 60 cents per unit while others paid 4 dollars per unit because they started earlier than we did and their product was therefore that much more expensive.

"A few years ago, one of our development managers was very excited about magnetic bubbles. 'You can't lose,' he said. 'We must jump on the bandwagon; we must be a leader or we'll lose out.' Even Gordon Bell said it was coming soon. We were reluctant to offend that development manager because he was so enthusiastic, but we said no. Well, five years later, it doesn't look like we've lost all that much. Waiting until we're sure has been a good policy. On the other hand, you can't survive by saying no to all new technology.

"The second area of compromise is merely red tape which includes scheduling and budgeting. Our engineering departments terrify me because I think we're training hundreds of people to be budgeters and schedulers and after awhile they'll all forget how to be engineers. Budgets and schedules are tools; they are not used instead of engineering. We've got to use them but that's all they are, just tools. We are engineers, and we are only useful as long as we're doing engineering.

"A third area of compromise is safety. There are many things that fail for which there is no excuse. We just really work to cover all the alternatives. Products shouldn't fail. In some areas there is no excuse for failure; the compromise comes in because you can't make everything absolutely safe.

"In engineering there are no excuses. It has to work. I sat at IBM for a year, which was the worst year of my life. I didn't have much to do, but I learned a lot there. I was representing MIT and the Air Force and I had to make certain the products were done right. I could nail them because they didn't have technical analyses on the steel racks, but I couldn't tell them to start at the joints because that wasn't in the requirements. I decided that all the people there were really making a list of reasons that if any failures occurred it wasn't their fault.

"We can't do that! We have to get the job done, make sure it succeeds and realize there is always some chance of failure. We mustn't make a list of reasons to show that if something goes wrong it wasn't our fault. When we schedule projects, the normal tendency of an engineer is to schedule the test point two years away; postpone the day of failure for two years. That's just not healthy. I have often thought I wouldn't hire my son at Digital. I think if I did I would have him go into our Computer Special Systems organization because they succeed or fail every month and learn from it. We should make all our mistakes easy ones, our failures small and have them come early, so we can learn.

"The fourth area of compromise that I worry about in modern engineering is the amount of time that people spend preparing presentations for marketeers (when they're not budgeting or scheduling). Let me tell you how it looks to an outsider. A group of engineers studies something, they think about it for months and they look at it from every angle. They know as much as can be known. They know exactly which way to go. But, either because they are cowardly and want someone else to take the responsibility for their decision, or for some mysterious reason I can't explain, they make massive presentations to marketing people and lay the question before them. Now the marketeers have never thought about the subject before. When engineers ask them for a point of view they get back from 100 people 100 points of view that become 1,000 points of view before the meeting is over. Because engineers have a project on which they don't want to do engineering, they'll work two years budgeting and scheduling, they won't do any work, won't read a magazine, won't look at a book, nor a catalogue and won't draw up our diagrams; because they won't do any real work until they have this 'buy-in' from marketeers.

"Another area of compromise comes in discipline. We follow sort of the New England tradition of revolutionary soldiers. We look and behave like rebels. We think we won the Revolution because the British soldiers marched in straight rows, fired their muskets in unison and never aimed, while the smart Americans fired at random from behind trees and stone walls. The real story is that whenever the British started shooting back, the Americans just ran. The whole fight that we're so proud of in Concord was one big mistake. The Americans were so undisciplined and disorganized they got the whole thing started by mistake. The Colonial rebels really didn't win until they hired some European officers who taught them how to march in straight rows, shoot on command, and stand their ground when the other side shot back. When they finally got discipline, they won the war.

"You can take all these great stories on discipline with a grain of salt. Complete discipline would be too much of course. It's a compromise. No discipline whatsoever and there's never any production at all. We have to have discipline in our organization, our lives, our way of doing things. Compromise comes in because too much, by definition, is too much.

"Another area of compromise is in management. Managers must always compromise. They can go to extremes. One extreme is to do it all themselves. The problem with this is that we can't get them to do anything right, because the projects have to stay small so they can do everything themselves. It frustrates the people working for them. It frustrates the boss. Nothing happens until he gets around to it. He's not a manager at all. The other kind of manager who maybe is even worse, abandons everything. Between these extremes comes the compromise. Managing is playing that compromise. The manager must realize this and always face it. There are all kinds of tricks you can use to help. One is to require people to schedule all their work and then submit reports. The preparation of these reports will, in fact, force people to comply and review the information they need to do their job. When something falls apart, you know it and can talk to the people who are in trouble. Engineering sometimes takes forever, but it always comes out. Those things we watch get done, and those we don't watch never get done. It's one of the tricks. Another trick to managing is to threaten people that you might do the job better than they.

"I had lunch with the editor of one of Boston's big newpapers and had been critical of him. As we were walking out he asked, 'Do you ever have trouble motivating these 30 to 35 year old people?' I said, 'Our trouble is we can't get them to go home!' My frustration with that newspaper is that the reporters don't know what they are doing. They report freely but don't know what they are writing about. I figured out what that editor should do. If he would say, 'Let it be known that every month I am going to become an expert on a new subject' but not tell anybody what those things were, it would change the whole organization.

"We used to work for Jay Forrester, one of the real pioneers in computers. We called his style pulse management. He would come in with one pulse. Pulse management can keep people on their toes because they can't ever tell when you're going to come down and pulse them and know more than they do. It keeps the whole outfit sharp! They had better be awake!

"The other area in working out this compromise is to delegate. Of course you can't abandon a project either or nothing happens. One technique is to read a little about warfare. If you are an officer charged with defending a position, you go by every hour and check every single machine gun and the troops manning them. You make sure your men are not dead, that they're not sleeping, or sick; that they haven't run away. You make sure they're ready every hour. There is no such thing as losing the position and then saying, 'Well, things seemed okay when I checked yesterday.' When you're a manager, you have to manage so that you know everything that is going on. There is no such thing as, 'I trusted so and so and he let me down.

"What happens to middle-aged people? In general, they want to get into management. Engineers want to retire from engineering. I think maybe society has forced us into doing that, and engineers ought to fight it. It's okay to be a manager; the company depends upon the availability of good managers. But we should never become managers because we want to 'retire' and get an easy job. There are no easy jobs. You ought to fight the temptation to retire and always take the hard jobs. Always work hard at it and when you become 40 or 50 you'll be in demand. During the last recession, many people in Massachusetts who were 45 and 50 were looking for jobs. They thought they couldn't find work because they were too old. I interviewed a number of them and consistently they said that they used to be engineers, or draftsmen, or machinists. But they got promoted into some administrative work for which they were paid very well. But now they couldn't find work. The secret of it, I think, is always to be something. Don't be a nothing. Be in demand. The interesting thing is that our society wants us to be promoted into a do-nothing administrative job. Be someone who's been something for 45 years and work hard at being *good* at what you do."

3 FACTS ABOUT DIGITAL

Digital Equipment Corporation, headquartered in Maynard, Massachusetts, is the world's leading manufacturer of interactive computers and a leader in distributed data processing. Its products include small, medium, and large-scale computer systems. Digital also manufactures a complete range of peripheral devices and interfacing equipment and provides comprehensive customer support services. Digital employs more than 63,000 people worldwide and has shipped more than 235,00 computers. For its fiscal year ended 24 June 1981, the company reported sales of $3.2 billion.

Since the company began in 1957, the commitment has been good for Digital and good for its customers. Digital's first computer, the PDP-1, broke the million dollar barrier in 1960, providing interactive computing capability for about $125,000. Digital's first minicomputer, the PDP-5, lowered the cost of interactive computing to about $25,000. (Its current equivalent costs less than $2000!)

Digital's computer systems revolve around four central processor families:

- The PDP-8 12-bit computer family was first used as laboratory tools. Today, it functions in machine control, real-time monitoring applications, process control, and a host of business and commercial applications.

- The PDP-11 16-bit computer family brought new technological advances to small computers. Compatible with processors from the LSI-11 to the PDP-11/70, it encompasses the broadest range of peripherals and software ever offered. These systems are used for everything from running a lathe to running a railroad.

- The DECsystem-10, a 36-bit architecture system, was the first commercially available time-sharing system designed to simultaneously handle timesharing, batch, remote job entry, and real-time tasks. DECsystem-10s are used by more data service companies to provide time-sharing services than any other system. The DECSYSTEM 20, a smaller version of our large computer capability, bridges the gap between the DECsystem-10 and the PDP-11.

- The VAX-11/780 is a multiuser, multilanguage, multiprogramming, high-performance computer system. It combines a 32-bit architecture, a virtual memory operating system, and efficient memory management to provide essentially unlimited program space.

To support this line of processors, Digital manufactures a full line of peripheral equipment including disk and tape systems, input/output devices, hard copy and video terminals, and communication interfaces. This large selection of peripheral equipment allows Digital's customers to tailor systems to meet their specific needs, with the assurance of expansion capability for future requirements.

Complementing the hardware offering, Digital offers software products such as application packages, operating systems, higher level languages, and utilities. These products provide the full capability to meet its commitment of increased performance at a lower price.

Possibly more important, Digital provides resources and services to support all of its products:

- Software support services which range from getting a specialized system up and running to writing a customized application program.

- A Field Service organization of more than 6,000 engineers worldwide who are available to service and perform preventive maintenance on all Digital computer systems.

- Sales, Software Support, and Field Service representatives provide sales and service from more than 400 locations in the US and 35 foreign countries.

- Over 300 computer-related courses are available to all Digital customers at worldwide training centers.

- DECUS, the Digital Equipment Computer Users Society, the largest such group in the world, sponsors symposia, publishes newsletters, and administers a program library for its members.

4 DIGITAL PHILOSOPHY

Digital philosophy as represented by the following statements reflects the kind of company Digital strives to be, to its employees and to the outside world.

HONESTY

We want to be not only technically honest, but also to make sure that the implication of what we say and the impressions we leave are correct. When we make a commitment to customers or to employees, we are obligated to see that it happens.

PROFIT

We are a public corporation. Stockholders invest in our corporation for profit. Success is measured by profit. With success comes the opportunity to grow, the ability to hire good people, and the satisfaction that comes with meeting your goals. We feel that profit is in no way inconsistent with social goals.

QUALITY

Growth is not our primary goal. Our goal is to be a quality organization and do a quality job, which means that we will be proud of our product and our work for years to come. As we achieve quality, we achieve growth.

RESPONSIBILITY

Plans are proposed by managers or teams. These plans may be rejected until they fit corporate goals or until the Operations Committee is confident of those plans. But when they are accepted, they are the responsibility of those who proposed them. The impetus for a plan may come from outside the group making the proposal, but once accepted, the proposal is the responsibility of the one who proposed it.

LINE MANAGEMENT

We particularly want to be sure that line management jobs are clear and well-defined. Because so many people are dependent on the plans of line managers, it is very important that the plans have regular automatic measurements built into them. Meeting financial results is only one measure of a plan; other measures are satisfied customers, development of people, meeting Digital's long range needs, development of new products, and the opening of new markets. We believe that our commitment to planning ensures our freedom to act.

SOCIETY

We are committed as a corporation to take affirmative action in providing equal opportunity for employment and promotion for all persons regardless of race, color, creed, or sex. We encourage all employees to take responsibility in community, social, and government activities. We are always open for proposals as to what the corporation or an individual on corporation time may want to do in these areas. However, activities done on company time or with company funds should have a formal proposal including ways of regularly measuring success toward goals.

ENVIRONMENT

As good citizens we have a responsibility to keep our environment free of pollution, and to set an example by these activities.

CUSTOMERS

We must be honest and straightforward with our customers. Not only must they be told the facts, but we must be sure they understand the facts.

To the best of our ability, we want to be sure that the products we sell answer the needs of the customer, even when that customer does not understand these needs exactly. When we sell a product to a customer, we want to be sure the corporation fulfills the obligations we took on with the sale. We sell our corporation, not a single individual, to our customers and we must be sure all Digital commitments are met.

COMPETITORS

We never criticize the competition publicly. We sell by presenting the positive features of our own products. We want to be respectful of all competition, and collect and analyze all public information about competitors. When we hire people from competitors, we should neither press them for confidential, competitive information, nor should we use confidential literature they may have taken with them.

SIMPLICITY AND CLARITY

We want all aspects of Digital to be clear and simple and we want simple products, proposals, organization, literature that is easy to read and understand, and advertisements that have a simple, obvious message. We have thousands of employees and many thousands of customers. We have to keep things simple to be sure that we all work together. Our decisions must always consider the impact on the people who are affected by them.

ORIGINAL EQUIPMENT MANUFACTURERS

Standard products are the basis of our business. At times we will invest in software and hardware specifically for special markets. But we should never lose sight that the base of our business is our standard products. We are very dependent on selling to OEMs. There are more applications for our products than we could ever develop. In addition, there are many risks to be taken in developing new fields which we cannot afford. Therefore we are very dependent on OEMs, and when they take the risks and they are clever enough to be successful, we should be most respectful of their risks. When our OEMs are in trouble with a customer, we should tell them.

PERSONNEL DEVELOPMENT

We encourage people to develop technical skills, breadth of knowledge, and expertise in a specific area. We also encourage people to develop supervisory and management skills. We believe that individual discipline should be self-generated.

PROMOTION

We promote people according to their performance, not only their technical ability but also their ability to get the job done and to take the responsibility that goes with the job. Ability is measured not only by past results, but also by attitude and desire to succeed. Performance results are also used to decide if a person should remain in his or her current job.

HIRING FROM CUSTOMERS

We should be exceedingly careful when hiring employees from customers. Sometimes this is reasonable and desirable; but we should do it with all caution and by being sure that the employee first tells the customer and allows the customer the chance to compete against us.

FIRST RULE

When dealing with a customer, a vendor, or an employee, do what is "right" in each situation.

5 DIGITAL STRUCTURE

Digital operates on a matrix structure which is not used by many companies. Therefore, most people are not familiar with how it works. Briefly, a matrix organization is one in which many members are responsible to more than one person. It enables people from all areas of the corporation to communicate, work together, and see one another's viewpoints. This way, people feel responsible for more than one primary aspect of the business.

A matrix organization is designed to provide checks and balances in decision-making as well as to ensure that major proposals receive full exploration from all interested parties. The matrix organization is one of Digital's greatest strengths, making it possible to view the overall business from a variety of perspectives. For example, it is possible to look at a single product across product lines from an Engineering or Manufacturing perspective. Sales may be viewed worldwide by product line. A single country, region, or district may be examined across functions and product lines. Product lines can develop and market products using the resources of Engineering, Manufacturing, and Customer Services organizations.

Engineering is the backbone and lifeblood of Digital, continually providing innovative products with greater capabilities. Engineering performs product development according to the plans agreed upon with product line Marketing. Engineering also performs advanced development and research, providing a high degree of technical specialization in Printer, Computer Systems, Software Engineering, and major corporate processes to maintain Digital as a major competitor in the marketplace. Engineering Services, Documentation Control, and Specification Control Systems are provided in support of Engineering.

Product Lines have most of the functions you would expect to find in a small company. Digital's three major product line groups are Commercial Products, Technical Products and Computer Products. The focal point for profit and loss measurement at Digital is the product lines. Product line managers are responsible for profits accrued by their market areas. One or more product lines within a market segment may be aimed at very specific markets, with resident Engineering groups established to meet the needs of those market areas.

Manufacturing's function is to produce Digital's products at the product's specified quality level, at a manufacturing cost that maintains a competitive position in the market, and to a schedule that meets our commitments to our customers. Manufacturing operations include approximately 32 facilities. United States locations are in New England, the Southwest, and the West Coast. International locations are in Puerto Rico, Canada, Great Britain, Germany, Hong Kong, Taiwan, and Singapore.

Manufacturing is composed of seven line organizations: Systems Manufacturing, Mass Storage Manufacturing, Terminals Manufacturing, CPU Manufacturing, Process Manufacturing, Component and Memory Manufacturing, and Far East Operations. Plant reporting is within these groups.

Sales have field offices in the United States, Canada, Europe, and General International Area locations to provide promotional and sales services. In order to serve the needs of the marketplace more efficiently, Digital's sales force is specialized; sales persons are trained to serve one or more specific market segments. For instance, there are sales representatives dealing with commercial markets, industrial markets, and educational institutions. Sales training is made available to the entire sales force.

Customer Services comprises many functions, three of which are Customer Service Systems Engineering, Software Services, and Educational Services. Customer Service Systems Engineering groups develop Field Service maintenance and business plans, hardware documents, training requirements, product safety requirements, reliability and maintainability programs, and evaluation of these functions during new product development. Software Services provides services to satisfy Digital's software needs in the field in the areas of warranty support, sales support, and consulting services. Educational Services provides training to anyone, customer or employee, interested in Digital hardware, software, or a variety of other computer-related topics. This group also designs and teaches custom-tailored courses to meet the special needs of a customer. They have extensive facilities in Massachusetts and in major cities around the world.

CHAPTER 2

PERSONNEL

Manager: John Meyer (ML3-4/A11, 223-2633)

Personnel works to enable all groups within Central Engineering to meet the following objectives:

- Attract, develop, and retain a competent, innovative workforce;
- Link business and organizational requirements with individual employee needs;
- Understand and manage the impact of corporate decisions and conditions on organizational effectiveness and employee morale;
- Develop programs and processes to facilitate communication among employees;
- Ensure that employees are treated fairly, and in a manner consistent with Digital policies and legal requirements;
- Develop, support, and manage related administrative and personnel programs, systems, and tools;
- Influence, participate in, and ensure the integration of group objectives and Corporate Personnel goals.

Personnel meets these goals through work in these and other areas of functional support:

- *Employee Relations*: Interpreting policy, solving problems, and providing counseling
- *Compensation and Benefits*: Salary planning and review administration; benefits configuration and administration
- *Staffing and Placement*: Recruiting, interviewing, and assimilating new employees
- *Organization and Employee Planning and Development*: Workforce planning, training, career and performance management, organizational diagnosis and consulting
- *Equal Employment Opportunity (EEO)/Affirmative Action*: Setting goals, reporting, developing awareness strategies
- *Administrative Systems*: Maintaining personnel data base, employee profiles and records

Every employee has the following individuals available to assist him or her with personnel issues:

The *Personnel Services Administrator* (PSA) keeps employee records. The Personnel Services Administrator also processes paperwork for tuition refunds, disability benefits, U.S. savings bonds, leaves of absence, taxes, increase letters (notice of salary increase), and automatic deposit agreements. They handle employee transfers, orient new hires, and help with retirements. The Personnel Services Administrator is the best source of information on benefits at Digital.

Your Personnel Services Administrator is responsible for keeping your personnel file up to date. You can help by supplying your PSA with changes to your address, home phone number, emergency contact, and other essential information. Your department has your Employee Profile, which enables you to keep these records correct.

The *Personnel Representative* advises employees in areas including career development and training, job performance, reclassification and transfers, and leaves of absence. Personnel Representatives work with management on issues of workforce planning, job descriptions, salary planning, Equal Employment Opportunity/Affirmative Action, and organization design and development. They sign personnel requisitions, salary reviews, relocation advances, vouchers, and exceptions, as well as training requests, tuition refund forms, and transfer and termination forms. They also conduct exit interviews.

Personnel Representatives make an effort to meet all new employees, either at an orientation or in an individual meeting, to answer any questions and address any concerns they may have.

Each group has a *Personnel Manager*, responsible for the overall management of the functions listed above. Personnel Managers ensure a productive balance between individual and organizational needs. They consult with group management and other senior-level group members on all aspects of Engineering's business that affect people, and provide strategic and long-range perspective on workforce planning issues.

CHAPTER 3

FUNDING FOR PLANNED AND UNPLANNED PROJECTS

1 PLANNED PROJECTS

The preparation of Engineering budgets is a year-round activity. Engineering is continually involved in the refinement of product development tactics and the evaluation of product development issues and opportunities which arise during the year. These activities dictate a need for flexible budget modifications.

The Engineering budget is determined by the Operations Committee at a formal review in March each year. The Committee approves a budget for the next three fiscal years. The budget for the next fiscal year is very detailed and has little reserve for "new ideas". The remaining years have progressively larger reserves, since our understanding of needs and opportunities is less clear the further we are from the time of actual implementation.

At the Operations Committee review, the major engineering programs present their current plans and status, followed by proposals for new projects. The following programs made presentations at the last Operations Committee review:

16-Bit Systems	32-Bit Systems
36-Bit Systems	Computing Terminals
Office Information Systems	Distributed Systems
Storage Programs	Semiconductor Engineering
Software Engineering Program	Process Technology Program
General Technology Programs	

Before the Operations Committee review, each program must analyze the market and technology opportunities in its area. They must consult with all other appropriate organizations within Digital to ensure that their proposals will meet the overall interest of the Corporation. Specifically, this requires formal interaction with Manufacturing, Customer Services, and the marketing Product Groups. Some Program Offices establish special committees as the basis for this interaction. Marketing task forces (MTFs), strategic planning units (SPUs), and product steering groups are examples.

Since it is essential that our engineering investments meet the business needs and respond to the opportunities defined by our marketing Product Groups, the marketing groups must receive special attention from Engineering. One or more times a year the engineering program offices make presentations and obtain feedback at staff meetings of the marketing Group Vice Presidents.

Engineers seeking funding for a product idea should follow the process and procedures defined by their engineering organization. Their group's management will decide whether to incorporate their suggestion into the formal proposals to the Operations Committee.

2 UNPLANNED PROJECTS

There are three sources to which engineers may turn for funding of unplanned projects. Unplanned projects may be funded by product lines, by receiving cross-funding from another engineering group, and by the Research and Advanced Development (RAD) Committee (see section 3.5 of Chapter 5 for a description of this committee).

Product Line Funding

If the project that the development or project manager proposes to undertake has application to a single product line, he or she can request direct funding by that product line. Each product line sets aside a certain percent of its net operating revenue to be used for product line engineering. The engineering group within the product line can finance a proposed project, or Engineering can fund the project directly. A project manager or development manager has access to these funds.

Cross-Funding

In those cases where an engineering manager is supplying services, he or she may receive cross-funding from another engineering manager. A typical example would be the services of the packaging group being used by a CPU development group.

Research and Advanced Development Funding

Occasionally, projects evolve from such alternative avenues as informal discussions, reviewing the current technical literature, and changing market demands. An engineer's personal interest in a particular idea may result in a "lunchroom" project, one which may ultimately benefit the company. To encourage and support such projects, Engineering allocates 1% of its research and advanced development budget each fiscal year for the research and development of unplanned projects. The total research and advanced development fund is 13% to 15% of the Central Engineering fund.

If you have a product that you believe will make a significant contribution to the future of Digital, submit your project to the Research and Advanced Development (RAD) Committee in the form of a preliminary project proposal. RAD will consider potential projects and permit you to sidestep regular management approval.

Your proposal should be submitted to a RAD Committee member or the technical coordinator of the RAD Committee, Nick Johnson (ML2-2/H33, 223-9223). It should briefly describe the nature of your effort, the resources required, the anticipated technical rewards, and the project's relationship to the organizational strategy.

The Research and Advanced Development Committee will review your proposal to determine if money should be spent to test the technical soundness of your project, and then hold a follow-up review by qualified engineers. RAD may also allocate funds to articulate your project to other levels within Digital (for example, Marketing, Manufacturing).

Because RAD receives more project ideas than it can finance, money is allocated only to those projects which demonstrate promise. Roughly half of all project proposals receive funding for further research.

CHAPTER 4

THE PHASE REVIEW PROCESS

PART 1: DEFINITION OF THE PHASE REVIEW PROCESS

PURPOSE OF THE PHASE REVIEW PROCESS IN CENTRAL ENGINEERING

Hundreds of projects are being developed within Central Engineering throughout the year. Most of these projects are products or components of products that are destined to be produced and sold by Digital within the next year or two. Many people outside a particular engineering organization urgently need to know what is being developed within: for example, they may need to plan promotion, allocate resources, schedule manufacturing or software distribution facilities, prepare handbooks or training manuals. It was in this context, the need to communicate project status to groups outside the development engineering group, that the already widespread use of the Phase Review Process model was made official throughout Central Engineering during 1980.

The Phase Review Process is both a model, using the concept of a product life cycle, which spans the functions of the total corporation (Engineering and Manufacturing, Marketing and Sales, and Customer Services), and a management tool used by Product Management. To understand the model, we will describe the idea of a Phase. To understand the tool, we will briefly explain the Review Process.

WHAT IS A PHASE?

Each phase of a product life cycle constitutes a "manageable chunk" of a different type of policy and operational effort. Central Engineering has developed a set of criteria, a checklist of minimum requirements to be met, to indicate that each market-destined product has been addressed by each organization that must act or react in the creation or support of that product. These criteria, within the 6 phases of the product life cycle, are given in the Central Engineering *Phase Review Process Guide*, available from your Operations Manager, or Central Engineering Operations (223-8776). (These phases are outlined in the next two parts of this chapter, on hardware and software projects, but these parts address engineering concerns only: the Phase Review Process is a policy and operational guide to Product Management and non-engineering issues as well.)

In addition, most Engineering Groups have added criteria specific to their own organization, and each product's detailed Phase Planner, listing the milestones that a given product team has agreed to produce within each phase, has added criteria. Apart from these minimum requirements, each product plan is unique.

The purpose of breaking down the total product effort into these phases is to create an event-triggered model of review. This is in addition to a "periodic" model of review: the monthly status reviews, the annual write-up in an operating plan, etc.

The events triggered by the end of one phase and the beginning of another are almost always a shift in resources allocated to a project: a commitment of funding, of lab resources, of human resources, of testing resources, of manufacturing plant resources. At these resource transfer points, engineering and non-engineering groups must collaborate to establish readiness, changes in plans, and so forth.

WHAT IS THE REVIEW PROCESS?

The Review Process is the planning and execution of the phases and phase transitions of a product life cycle. Typically a project team has primary responsibility for coordinating the engineering development work with the business and support functions of the corporation.

This manager is responsible for defining and scheduling the overall phase activities (as described in the *Phase Review Process Guide*, above in *What is a Phase?*) and managing the Phase Transition Review Meetings. The manager will send out an announcement of this meeting time and location, and distribute the required phase transition documentation for review. At the meeting, representatives of each group in the corporation involved in this or the next phase of the product life cycle review and approve documentation, raise and discuss issues, and conclude with either transiting the phase, transiting with conditions, or rescheduling the meeting. In concluding the Review Process, the manager publishes a memo with the minutes of the meeting, indicating the status of the attempted transition.

WHICH DEVELOPMENT EFFORTS ARE REQUIRED TO USE THE PHASE REVIEW PROCESS?

Basically, all products destined for the market place use the process. The following criteria are usually cited for development efforts that may be required to use the process regardless of the end-user.

- Product is to be developed within Central Engineering.
- Product is to be routed through the Corporate Pricing/ Policies Committee (P/PC) for Product Announcement and First Customer Ship.
- Project is to report in the monthly Central Engineering Project Status Report (Yellow Book).

These Pricing/Policy Committee product classifications would each use the Phase Review Process. A modified version of the Review Process may be used in low-impact development efforts (see H3 and S3 below, and the Phase Review Process document for allowable modification).

1. Systems: New CPUs, new Operating Systems, and others as designated by Product Management.
2. Hardware 1 (H1): New products expected to generate revenue in the high bracket (over \$16M at this writing, see P/PC Policies for latest bracket value). Examples: COMET, HSC50, VT100, RX04, 11/23, MINC.
3. Hardware 2 (H2): New or modified products expected to generate revenue in the lower bracket (under \$16M at this writing, see above). Examples: HIGH IMPACT CHANGES, PCL11-B, CMS11-K, ICS11, IP300.

4. Hardware 3 (H3): Minor enhancements to an existing product or add-on. Example: DUP11 on VAX.

5. Software 1 (S1): New high-impact product or major enhancement to an operating system. Examples: TRAX, SCS, RSTS, VMS, TOPS-20, PDT, MINC.

6. Software 2 (S2): New version of existing product or low impact product. Examples: BASIC, MUMPS, third party applications.

7. Software 3 (S3): Maintenance release.

Note

Contact Digital Standards Administration (ML3-2/E56, 223-9475) for copies of Standards and Specifications listed below.

PART 2: THE LIFE OF A HARDWARE PRODUCT

SCOPE

From product inception, through steady-state production, to product retirement, a hardware product passes through 6 phases:

PHASE 0: STRATEGY AND REQUIREMENTS
PHASE 1: PLANNING
PHASE 2: IMPLEMENTATION
PHASE 3: QUALIFICATION
PHASE 4: PRODUCTION AND SUPPORT
PHASE 5: RETIREMENT

This is an overview of the life of a hardware project, from the perspective of the engineering function, in the sequence of the 6 phases. Information pertinent to Engineering Development has been extracted from the "Policies and Procedures" references listed at the end of each phase and restated here. For full detail of the other functions (for example, Customer Services, Manufacturing, Product Management) involved in the life of a hardware product, and for more detail on policies for Engineering, refer to the sources listed.

This presentation is intended only as a general orientation: to help development engineers determine their responsibilities, understand their roles, and learn about groups they will potentially contact and work with during the product life cycle.

ENGINEERING'S GENERAL PRODUCT DEVELOPMENT RESPONSIBILITIES FOR MARKET-ORIENTED PRODUCTS

At Digital we have a saying about how to make decisions: "Do it right". For the Development Engineer, "doing it right" hinges upon clear communication to and from engineering groups.

1. The "right" thing to do is defined by the joint effort of marketing, product management, customer service, manufacturing and engineering. Keeping in mind that malfunctions in application are often expensive and costly, that a product must be marketable to be worth the

development effort, and that manufacturability is an essential in the design of the product, the development engineer must be receptive to the needs of the representatives of these organizations and allow the necessary adjustments in the technical design to assure quality and safety.

2. "Doing it right" is also a reminder that, as the development effort evolves, the key to success lies in the clear and precise communication of engineering ideas. Although the working model, or engineering "prototype", is the most tangible form of engineering communication, non-engineering groups working on the product will require information in the form of clear, unambiguous documentation directed to the needs of their particular expertise. *How well the Engineering team forges the crucial link between technical knowledge and the other areas of knowledge that will ensure the product's success as it evolves through the product life cycle:* this is the true measure of Engineering's contribution to the product.

THE PHASE REVIEW PROCESS FOR HARDWARE PROJECTS

The following pages identify:

- the objectives of each phase, including non-engineering as well as engineering goals;
- the groups involved, other than the engineering team;
- the Development Engineering group's responsibilities, including Central Engineering's documentation phase transition exit criteria, and other criteria that have been established for all market-destined products;
- and tools: policies, procedures, background research, and groups to consult for further orientation.

PHASE 0: STRATEGIES AND REQUIREMENTS

The Development Engineer's Role in Phase 0

The purpose of Phase 0 is to assess the risks of a go/no decision on product development. It might appear that the engineer's role in Phase 0 is to adopt a "wait and see" attitude until lab and human resources are fully allocated and the project team is ready to start the specifications and prototype. But this is not true. A core of engineers become active in Phase 0 for technical contributions, the two below are minimum:

DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 0 TRANSITION

- Write and publish the Alternatives and Feasibility Document. This document is a summary of the engineer's research and understanding of any technical risks involved with solving the problem. It assesses the relevant states of the art of technology in general, in our industry, and within Digital. If there are no technical risks, this is clarified. Alternative solutions are outlined, and the most promising solution, from the perspective of current or evolving technology, is justified.
- Provide information and review and comment prior to publication of the Business Plan, Market Requirements, and Product Requirements documents. These three documents are written and published by the product manager, with the support of engineers, Marketing, Manufacturing, Customer Services, and other functional groups. Part of your job as a consultant on these documents is to participate in the scoping and planning of the project. Part of it is to

provide the product manager with specific information on request, particularly for the Product Requirements document. This cursory document includes clarification of functionality, operating environment, and special requirements which will be detailed later by the development engineering staff during Phase 1 in the Functional Specification.

Tools

Policies and Procedures

- *Phase Review Process*, Phase 0 requirements, Appendix B
- *General New Product Startup Manual* (Manufacturing)
- *Design Review Process* (DEC STD 007)
- *Design and Certification of Hardware* (DEC STD 060)
- *Environmental Standard for Computers and Peripherals* (DEC STD 102)
- *System Business Plans* (DEC STD 130)

Background Research and Consultation

- Corporate Library, Technical Information Center (ML4-3/A20, 223-7963)
- Market Data Center for competitive product research (PK3-1/S52, 223-2504)
- Central Engineering Data Center: product documentation archives (ML12, 223-8776)
- Environmental Engineering Laboratory
- FCC Program Office

PHASE 1: PLANNING

Objectives

- To categorize the hardware product into one of the 4 P/PC categories (see explanation in PART 1: PHASE REVIEW PROCESS)
- To generate a master schedule of the development effort and product support throughout the product life cycle
- To identify all resources required in the development effort
- To generate cost estimates of the total development effort
- to provide detailed description of the product in its operating environment, from which a design description may be created
- To create a commitment within the Corporation to implementing this master plan in the remaining phases of the product life cycle

The groups listed below have developed special expertise in their own areas. The assistance they offer is presented in detail in other sections of this manual. In Phase 1, this list may be used as a resource checklist for determining which groups to contact.

- Manufacturing Representative for New Products
- Software Engineering
  Defines software user documentation; helps to define schedules to relate to major operating system releases; helps to define software interface; creates drivers and defines intelligent tests and standards; helps define engineering specifications for compatibility, migration, and new functionality
- Component Engineering
  Helps research and specify component needs

- Purchasing
  Helps with vendor selection, sourcing, and problem solving
- Engineering Services
  Provides manual and automated design drafting/printed circuit layout; acts as a communication link for all Engineering Services
- Standards and Methods Control
  Provides copies of Digital Standards
- Technical Systems and Services
  Provides resources for optimizing the manufacturability of printed wiring boards, modules, and backplanes
- Diagnostic Engineering
  Assists in hardware/software tradeoffs and logic partitioning decisions; generates diagnostics for your product
- Model Shop
  Supplies fabrication in metal, wood plastic, clay and foam; assembles prototype modules, small assemblies, and cable harnesses; provides PC board modules, hand testers, low volume blasting of PROMs and ROMs
- Educational Services Development and Publishing
  Provides technical documentation planning, technical writing services, publication services, printing and distribution services
- Mechanical Engineering
  Designs packaging, evaluates materials, measures heat transfer and flow, tests connectors; designs castings and molded parts
- Industrial Design and Industrial Packaging
  Performs industrial design, formulates appearance, packaging, and product design concepts (panels, colors)
- Customer Service Systems Engineering
  Helps design support features and plans for field support (the Support Plan introduces the product to all Field Service offices)
- Reliability Engineering
  Provides early Mean-Time-Between-Failure (MTBF) predictions
- Appropriate Process Engineering Group
  Consult with your Manufacturing contact about Digital's way of manufacturing and testing of a new product; if necessary, Manufacturing can design fixtures and tools to facilitate the manufacture and testing of a new product
- Manufacturing Test Applications
  Assists in Hardware/Software decisions to generate diagnostics for Manufacturing applications

Development Engineering's Role in Phase 1

In this phase, Engineering team members focus on refining the technical goals of the product, and specifying what actions must be undertaken in order to achieve the technical goals. For completing Phase 1, the engineering staff has the design, and schedule for implementing the design, defined to a level of detail such that a prototype may be begun in Phase 2. This information will be captured in the Functional Specification and the Design Specification.

You may have noticed that the Design Specification is not listed as a specific phase exit criteria for Phase 1; it is usually started during Phase 1 as soon as the Functional Specification has been drafted, and may be completed during Phase 1 or 2 (the Design Specification is frozen as Phase 2 exit criteria).

As part of the design stage of development, projects involving a higher level of complexity of design or evolving technology may require the formation of a Design Review Committee. This process has been a standard procedure at Digital for many years, and constituted the early version of a process not unlike the current phase review process (the major difference being the extension of "event-triggered" rather than periodically scheduled reviews to cover the whole product life cycle, rather than just the design cycle). A Design Review process may be integrated within the overall product life cycle phase review structure: the Design Review Committee meeting is used to focus more on technical issues than on planning and major business issues. The bulk of the Design Review Committee effort takes place in the product life cycle Phases 1, 2, and 3. To find out more about the Design Review Process, see Background Research and Consultation for this section.

DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 1 TRANSITION:

- Write and publish the Functional Specification. This document is the engineering blueprint for guiding all subsequent technical development required for the product. More concrete and specific than the Product Requirements document in Phase 0, but more general than the detailed Design Specification, the Functional Specification identifies, in technical terms, what the end product must do to meet user and environmental requirements. It will serve as a cross-reference check for subsequent effort.

- Provide information and review for the *Business Plan Phase 1 Revision*, and the *Project Plan*. As in Phase 0, development engineers consult, advise, and provide specific information on request of the authors of these documents.

- Development Management approval of each of these documents at the Phase 1 transition review constitutes Engineering's commitment to the schedule and cost for the remainder of the development effort.

Tools

Policies and Procedures

- *Phase Review Process*, Phase 1 requirements, Appendix B
- *General New Product Start-up Manual* (Manufacturing)
- *Module Manufacturing Standard* with PDG Questionnaire (DEC STD 030)
- *Field Maintenance Print Sets* (DEC STD 117)

Background Research and Consultation

- *Design Review Process* (DEC STD 007)
- Contact the Office of Chief Engineer (ML3-3/H14, 223-6208) for forms and procedures concerning the Design Review Process.

PHASE 2: IMPLEMENTATION

Objectives

- To resolve the last design problems by finalizing and testing base-level prototype(s)
- To freeze the design (formal ECO control of the design, the parts list, and the part descriptions at the end of Phase 2)
- To select facilities and schedule Verification Testing required to qualify the product for the target market(s)
- To finalize Manufacturing, Marketing, and Customer Service commitments for the planned activities of Phase 3

Groups Involved

- Engineering Services: Component, Design, Drafting, and Diagnostics Groups
- Engineering Quality Groups: Environmental, Product Safety, and Reliability Engineering
- Manufacturing Test Applications, Design Maturity Testing
- Model Shop
- Product Lines
- New Product Marketing
- Sales
- Finance
- Customer Services

Development Engineering's Role in Phase 2

Phase 2 is the turning point of product development within the 6 phases of the life cycle. In Phase 2, we begin to pivot away from development within Engineering to readiness for the manufacturing plant and marketplace. Engineering has three goals in this phase.

The first goal is to implement the engineering design concepts developed in strategic and planning phases. The implementation task culminates in a final prototype, created by Engineering, with the help of such services as the Model Shop, Drafting, and Industrial Design. The focus here is on marketability: the prototype must conform as closely as possible to the needs of the market as defined in the documentation produced during Phases 0 and 1. A Design Review Committee, if formed, will help with technical issues of applied engineering for this task.

The second goal is insure that any "bugs" discovered in the design or prototype have been ironed out, that engineering has internally reviewed and approved the work prior to prototype release to Test, Manufacturing, and Service organizations. Both manufacturability and maintainability are essential in the engineer's definition of "design approval". If a Design Review Committee has been formed, they will meet for a Final Specification Design Review to help the development engineers establish that specification to design has been achieved.

The final prototype, accompanied by a design specification, engineering drawings and other pertinent documentation, will be used for the verification and maturity testing performed throughout the remainder of Phase 2 and Phase 3. When design maturity has been verified, the team will freeze the design, placing the design specifications under Engineering Change Order (ECO) control. This means that no new functionality or changes in design (architecture) may be generated without a formal approval process since these kinds of changes usually have a significant impact on the product content, delivery schedule, and development cost. Changes to the prototype that do not alter design or functionality are incorporated during the base-level and verification testing.

The third goal is to plan and schedule the verification and maturity testing that will occur through Phase 3. These plans take into account the intended market (including international), manufacturing process, and scope of service to be provided. Component Engineering, Diagnostics and Reliability Engineering are groups that can aid in the planning of the Verification Testing and Analysis. Digital has environmental test chambers that test for heat, humidity, supply voltage, frequency, and other factors that affect product safety and performance. External test facilities may also be required.

DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 2 TRANSITION:

- Write and publish the Final Base-Level Prototype Test Results Report, a prerequisite for verification/field test ring; and the Verification Test Plans, which specify the role of each inhouse and external (if required) testing groups in the next phase.

- Provide information and review for the Phase 2 Business Plan, the updated revision of the Phase 1 Business Plan.

Tools

Policies and Procedures

- *Phase Review Process*, Phase 2 requirements, Appendix B
- *Parts Lists* (DEC STD 025)
- *Module Manufacturing Standard* (DEC STD 030)
- *International Certification Standards* (DEC STD 060)
- *Environmental Standard for Computers and Peripherals* (DEC STD 102)
- *Digital Product Safety* (DEC STD 119)
- *Etch Board and Module Release Verification Requirements and Procedures* (DEC STD 142)
- *Wirewrap Backplane and Wirewrap Module Release Process* (DEC STD 181)
- *Process Maturity Test Specification* (A-SP-7665268-00-0001)

Background Research and Consultation

- *DEC Field Service Philosophy*
- *ECO Handbook* (A-MN-ELENECO-0-0) (Available from Digital Standards Administration)

PHASE 3: QUALIFICATION

Objectives

- To measure compliance to all existing Corporate, Industry, and Government Agency standards applicable to the product's target markets

- To plan and schedule the introduction of the product into the manufacturing process of the specified manufacturing plant(s)

- To plan and schedule the introduction of the product in the marketplace (including advertising, selling, servicing)

Groups Involved

- Product Management
- Engineering: Drafting, Environmental, Software, Diagnostics, Component, Reliability, Process
- Manufacturing: Test Applications, Plant Management, Plant Materials
- Customer Services: Systems Engineering, Field Services
- Purchasing
- Finance
- Sales
- Product Lines, Product Line Marketing
- Corporate Pricing/Policies Committee (P/PC)

Development Engineering's Role in Phase 3

Phase 3 focuses on ensuring smooth product introduction, both into the manufacturing start-up process and through the Corporate criteria for introduction into the public marketplace. In Phase 3, product management, manufacturing, marketing, sales and service groups are mobilized, according to the documentation and planning created in the earlier development phases.

To qualify the product for the designated target markets, Engineering and Quality Groups usually put a number of prototypes through rigorous tests. The Product Manager attends to the P/PC checklist for Product Announcement and First Customer Ship (FCS). The Engineering tasks on this checklist are extracted below. See your Product Manager for the complete checklist, including criteria of Manufacturing, Customer Services, and other groups.

ENGINEERING TASKS REQUIRED BY PRICING/POLICIES COMMITTEE FOR PRODUCT ANNOUNCEMENT AND FIRST CUSTOMER SHIP (FCS) OF HARDWARE PRODUCTS

- Implementation complete (note, base-level done at phase 2 transition for H1 and H2; this item is implicit for H3)
- Qualification Phase complete (for H1 and H2)
- Demonstration of DEC STD 102 Compliance
- Demonstration of Product Safety Compliance
- Demonstration of FCC Compliance
- System Environment/Evaluation Test Phase 2 and Design Maturity Test (DMT) complete (for H1); or, Reliability Evaluation Results (for H2, if planned) (with Manufacturing)
- Run Time and Coverage goals demonstrated (for H1 and H2); or, "Diagnostics Available" (for H3) (with Diagnostic Engineering)
- FCS Diagnostics signed off (for H1 and H2) (with Diagnostic Engineering)

If product is designated as a "system", add (with Product Management):

- Statement on System Performance
- Statement on Digital Product Positioning
- Statement on Competitive Product Positioning

Note

Hardware categories (H1, H2, H3) are defined in PART 1 of this chapter.

OTHER DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 3 TRANSITION

In addition to the documentation required by P/PC criteria, the project team requirements from development engineering are:

- Edit and publish the Final Report of Verification Testing Results: each test area writes its own evaluation report and submits it to the Development Manager for compilation and final report publication.

- Provide information and review for the Phase 3 Revision of the Business Plan.

Additional Tools

Policies and Procedures

- *Phase Review Process*, Phase 3, Appendix B
- *Hardware Field Test Policy and Procedures* (contact P/PC)
- *Purchase Specifications* (Component Engineering)
- *Design and Certification of Hardware Products* (DEC STD 060)
- *Digital Product Safety* (DEC STD 119)
- *Etch Board and Module Release Verification Requirements and Procedures* (DEC STD 142)
- *Wirewrap Backplane and Wirewrap Module Release Process* (DEC STD 181)

Background Research and Consultation

- Component Engineering, for testing and incoming inspection
- Manufacturing Training Services, for in-plant training
- Diagnostic Engineering, for tester software and in-plant support
- Manufacturing Tool Generation, for templates
- Process Engineering for volume production test requirements
- New Product Reference Library
- *General New Product Start-Up Manual*

PHASE 4: PRODUCTION AND SUPPORT

Objectives

- To transfer ECO control from Engineering (Phase 4A) to Manufacturing (Phase 4B)

- To evaluate the product development effort

- To evaluate the manufacturing process for Quality Certification

- To manufacture and market the planned volume of the product

- To evaluate the market performance of the product

- To generate strategy for the orderly phasing out of the product, from the point of peak (or steady-state) volume manufacturing through retirement

Groups Involved

- Product Management
- Development Teams
- Engineering Support Management (Product Assurance Groups)
- Manufacturing Plant Management
- Plant Manufacturing Support Management
- Product Lines
- Customer Services
- Sales
- Finance
- Corporate Pricing/Policies Committee

Development Engineering's Role in Phase 4

The Engineering focus in phase 4 is to establish how and when engineering support for the product will occur as the product is transferred into Manufacturing. These problems include determining who performs the engineering required for ECOs, which group controls the project accounting, etc. There is no universally applicable rule of thumb for this transfer, since complexity of design, projected volume, projected life of the product, and many other factors are considered in developing the support required.

Once the transfer is agreed upon and occurs, the product completes phase 4A. Further Engineering contribution depends upon this agreement.

DOCUMENTATION REQUIRED OF ENGINEERING FOR PHASE 4 TRANSITION

- Contribute to and review the Post Partum Review, with Product Managment, after volume production and field data exist.

- Contribute to and review the Retirement Business Plan, with Product Management, upon maturity of product life cycle.

Tools

Policies and Procedures

- *Phase Review Process,* Phase 4, Appendix B
- *Engineering Change Orders* (DEC STD 100)

Background Research and Consultation

- *Product Certification Policy* (A-SP-7665327-00-0000)
- *System Business Plans* (DEC STD 130)

PHASE 5: PRODUCT RETIREMENT

Objectives

- To generate and carry out operational plan of scheduled activities for the phasing out of the product.

Groups Involved

- Product Management
- Manufacturing
- Product Lines
- Customer Services
- Sales
- Finance

Development Engineering's Role in Phase 5

As a product's life cycle continues, and as new products are developed and introduced in its wake, volume of sales and volume of manufacturing begin to level off. When the product is no longer anticipated to contribute to customer needs, and as it becomes more expensive to support, the decision to phase out the product will come. Many groups must be coordinated in the effort to phase the product out of their lists, accounting, and support activities. Engineering may have a role in this phase. Refer to the Retirement Business Plan, and other criteria in your area regarding phase-out.

Tools

- *System Business Plans* (DEC STD 130)

PART 3: LIFE OF A SOFTWARE PROJECT

SCOPE

This section contains general information for software engineers regarding computer facilities, quality methodologies, the software development process, and the Phase Review process. This section addresses:

a. who is involved

b. what documents/activities are required

c. when the documents/activities are required

This section is not intended as a substitute for the more detailed *Software Development Policies and Procedures Manual*. It is intended only as a pointer to that manual by providing an introductory overview of the software development process (contact Gladys Pannell, ML3-5/B39, 223-5860, for a copy of the *Software Development Policies and Procedures Manual*).

GENERAL INFORMATION

How to Develop Quality Software Products

Software Development uses certain processes and tools to ensure the quality of software products. For example, *code inspections* carried out periodically in the development of software attempt to spot problems before they become expensive problems. The more bugs found early in the development process, the easier it is to maintain the product later. In the published literature on this topic, one study has shown that an error that might cost $50 to fix in the requirements stage costs $1800 to fix in the integration and systems test stage.

One method of spotting problems early is the process of using *base levels*. Base levels are stepping stones in the development of software. The Project Leader plans and controls what goes into each base level. These are functional stages (that is, each base level is a testable unit that can run alone) which build on one another until code is developed which has many functions. Because many people must work on code beside yourself, the practice of using base levels allows others to integrate their base level functions with yours at various stages of coding.

Tests are performed after base levels are reached to build confidence that the code does what it is supposed to do as it continues to evolve. A clear advantage in using base levels is that as each level is tested and finalized, later debugging of the complete code can be kept to a minimum.

To further ensure the highest quality in software products, Software Development uses a standard high-level language for software projects. For this purpose, BLISS is the preferred implementation language. BLISS implementations are normally cheaper and easier to maintain than assembly language implementations. They also offer opportunity for reasonable portability for part or all of the program under development. For more information about Software Development's policy on BLISS usage, see the *Software Development Policies and Procedures Manual*, Section 7A3-2.A.

Another method of ensuring the quality of software products is the process known as *DECnet certification*. Certification is a method of validating a product's ability to carry out its DECnet functions with all other DECnet products. The purpose of this method is to establish a single set of standards to maintain general interconnectability among DECnet products. It is also used to ensure the compatibility of products at the user level. As Digital grows, certification will be used for most software products.

Ensuring quality software products also includes meeting the *minimum ship criteria*. The minimum ship criteria must be met prior to the submission of a software product to the Software Distribution Center (SDC) for shipment to customers. Before submission to the SDC, there is a 30-day "code freeze" period during which a product is installed, verified, and tested. Minimum ship criteria which must be met during this period include installing and verifying the code and publications, checking size, performance, and compatibility, and testing the product in intended market environments. Be sure to allow enough time during the development process for these criteria to be met. Consult the *Software Development Policies and Procedures Manual*, Section 7A3-1.A, for full particulars regarding the minimum ship criteria.

Software product quality extends far beyond developing programs with few bugs. Quality represents a multitude of factors often overlooked by people developing programs. Ultimately, it is how our products are perceived in the marketplace by the user. To this end, Digital is working toward improving user perceptions of installability, ease of use, human engineering, performance, maintainability, compatibility, and reliability.

SOFTWARE DEVELOPMENT PROCESS

The Software Development organization has developed its own processes for orderly and effective development and support of our software products.

The six successive development phases are:

PHASE 0: STRATEGY AND REQUIREMENTS
PHASE 1: PRODUCT PLANNING
PHASE 2: IMPLEMENTATION (including internal testing)
PHASE 3: PRODUCT QUALIFICATION (field testing) AND RELEASE
PHASE 4: PRODUCT PRODUCTION AND SUPPORT
PHASE 5: PRODUCT RETIREMENT

The Product Manager is the chief coordinator of the development of a software product. He or she is responsible for coordinating the actual development (design and programming) with other activities that impact the product, for example, Marketing, Sales, Training, Documentation, and Software Services. In general, the Product Manager ensures that all affected groups have an identified contact person for the project, and that those people are kept apprised of important information relating to the project and product.

Note that not all projects have a Product Manager, but every project has a Project Leader. If there is no Product Manager, the Project Leader must establish communication with other support groups (Marketing, Sales, Training, Documentation, and Software Services).

The actual design and development of the product are the responsibility of the Software Engineers on the development team. These engineers are responsible for the success of the product as measured by the quality of the design and the success of the implementation.

In the development of a software project, the activities of various groups are concurrent. Greatly simplified, these activities are:

Group	*Activities*
Development	Plan, develop, test, package, release, and maintain a software product
Software Quality Management	Represent user in-house by establishing quality goals, monitoring development activity, and assessing risk in shipping a software product
Software Documentation	Write manuals for use by customers
Software Distribution Center	Reproduce, stock, and distribute software and accompanying manuals
Product Management	Manage the business aspects of a product throughout its life
Software Services	Support customers in using a software product
Educational Services, Software Services Training, Sales Training	Provide training courses for customers, employees, sales people, and development personnel

The software development process requires detailed documents at specified times. Consult the *Software Development Policies and Procedures Manual* for a complete list and description of all required documents. Four key documents are described below:

> The *Project Plan* provides a conceptual overview of design objectives, an overview of required features both internal and external. It identifies interfaces with other projects and products, and it identifies all subsequent documentation requirements. It includes budgets, schedules, and staffing requirements. The Project Plan either contains the related plans or explicitly points to them. This document represents the commitments of the project.

The *Functional Specification* describes in detail the external characteristics of the software product. External characteristics are those observable to or under the control of the user of the product. All features of the system actively under the control of the user are defined. Those items that are only passively under user control, for example, listing formats or diagnostic messages, are described in sufficient detail to determine their applicability.

The *Functional Specification* is a design-to document and, as such, describes the product sufficiently for detailed design to commence. All hardware and software compatibilities, standards compliances, dependencies, macro calls, interfaces, and files are identified as well as size and performance objectives. Furthermore, all known limitations or functional capabilities not implemented should be specified. This information should be sufficient for all support groups to proceed.

The *Design Specification* defines the internal design of a software product and becomes part of the Internal Maintenance Specification. It pinpoints the software technology involved and defines the internal structure and tables. It specifies intrasystem calls, delineates all interdependencies, and describes the method to be used for the implementation of the Functional Specification.

The Software Product *Business Plan* identifies and describes the software product to be developed, the goals and non-goals of the project, its assumptions and constraints, and the target markets and applications for the product. It also includes an analysis of the competition, technological considerations and implementations.

CHAPTER 5

ENGINEERING DEVELOPMENT GROUPS

As an engineer, you will often need to contact Engineering groups outside your local domain for assistance and services. The following pages describe the functions of various Engineering groups. Information is provided to help you determine when to contact a group and whom to contact.

These organizations make up the core of Engineering at Digital:

1 16-Bit Systems

2 Software Engineering

3 Systems, Architecture, and Technology

4 LSI Manufacturing and Engineering

5 Storage Systems Development

6 Distributed Systems

7 32-Bit Systems

8 Large Systems Product Development

9 Terminals

10 Computing Terminal (CT) Program

11 European Engineering

1 16-BIT SYSTEMS
Manager: Mike Gutman

The 16-Bit Systems Program has three major functions:

- Line management for all 16-bit hardware development and support activities, except those associated with terminal products
- Software program management for all 16-bit systems
- Line management of advanced development of $10,000-30,000 systems

1.1 16-BIT SYSTEMS HARDWARE DEVELOPMENT
Manager: Herb Shanzer (ML1-2/E60, 223-5159)

16-Bit Hardware Systems Development is responsible for Digital's traditional 16-bit systems products (both Q-bus and Unibus), and all PDP-8-based products. Responsibilities include not only designing the specific CPU hardware, but also integrating complete systems offerings, including software, peripherals, and packaging.

1.1.1 Advanced Development
Manager: Donald Gaubatz (ML1-2/E60, 223-4858)

Advanced Development is responsible for investigation and predesign studies on those systems issues that are crucial to our next generation of products. Areas of activity include working with Software Engineering's CPU chip development group, bus structures and implementation, self-installability and ease of use, packaging, and manufacturing issues.

1.1.2 16-Bit Product Support and Assurance
Manager: Dan Casaletto (ML21-4/E10, 223-3618)

This group supports ongoing 16-bit systems. They work with Manufacturing, Marketing, and Customer Services to resolve production and customer problems, and to improve product quality and yields. Their product assurance function ensures that new 16-bit systems meet all of Digital's product standards. New systems must be compatible with other PDP-11 family products, and have a known level of performance as measured against established product requirements.

1.1.3 J-11 Development
Manager: Gerry Goodrich (ML1-2/E60, 223-3085)

This group develops new systems using the J-11 chip set. They work closely with the J-11 Development group of Semiconductor Engineering (see 4.1 of this chapter), and are developing the 11/24J system.

1.1.4 F-11 Development
Manager: Paul Gardner (ML1-2/E60, 223-5937)

This group develops traditional PDP-8-based systems, such as the VT278 and RL278, and traditional PDP-11-based systems, such as the 11/23B. They support existing and PDP-8 products, as well as those under development in the product lines.

2 SOFTWARE ENGINEERING
Manager: Bill (B.J.) Johnson (ML12-3/A62, 223-3982)

2.1 BASE SYSTEMS SOFTWARE
Manager: Bill Heffner (ZK1-3/J35, 264-8348)

The Base Systems Software group (BSSG) develops competitive real-time and general purpose software products. They provide other Digital groups with base-level software systems on which these groups can build products. The BSSG organization includes product development groups that design, implement, maintain, and enhance software products. Also included are product and quality management groups, and a publications group that develops user documentation.

Descriptions of these groups follow. Contact the appropriate group when you need information about products being planned or developed. Additionally, contact them when you identify future requirements that can be met by this organization's expertise.

2.1.1 Base Systems Quality Management
Manager: Brad Glass (ZK1-1/D19, 264-8400)

This group is responsible for software quality program definition and implementation for base systems software. Group activities include quality management, all software field tests, product assurance, test systems development, and performance measurement for all VAX/VMS and RSX software.

The group's emphasis is on providing a user-oriented quality perspective on software development activities.

2.1.2 Base Systems Software Product Management
Manager: Kurt Friedrich (ZK1-3/J33, 264-8328)

Base Systems Software Product Management manages software products built at Spitbrook. These products include VMS, RSX, RMS-11, RMS-32, DECnet VAX, FORTRAN, PL/1, C, PASCAL, APL, and Ada.

Software product managers are the primary interface among Engineering, other groups within Digital, and the customer base. They manage the Phase Review Process (see Chapter 4), define product requirements, generate business plans, introduce new products, and manage DECUS activities.

2.1.3 VAX/VMS Systems Development
Manager: Joe Carchidi (ZK1-1/D42, 264-8426)

This group develops and maintains operating system software for the VAX-11 family of computer systems, VAX/VMS. VAX/VMS also provides a base system for a broad and growing range of languages and applications software.

The group is also responsible for ensuring that all VAX-11 software products are perceived by customers as part of one, high-quality product offering. To ensure this, all corporate VAX-11 products must be approved by this group before their release.

2.1.4 RSX/RMS-11 Systems Development
Manager: Eric Baatz (ZK1-3/H21, 264-8217)

The RSX/RMS-11 Development group develops, produces, and maintains certain base systems upon which Digital products can be built. In addition to building two real-time products, RSX-11M/S and RSX-11M-PLUS, upon two of those bases, the group ensures a total product set of the highest quality. Real-time products in combination with languages, networks, file systems, and so forth, must constitute a high quality, competitive offering.

The RSX/RMS-11 Development group also develops, produces, and maintains RMS-11 (Record Management Services). This product is in the unique position of being a base system to a number of languages and a layered product to a half-dozen PDP-11 operating systems.

In addition to developing drivers, executives, file systems, and utilities for our own products, the group contributes key components to other products, for example:

- Mass storage drivers, file system, and many utilities for IAS (Interactive Applications System)
- Several any-compatibility mode utilities for VMS
- Support and maintenance of several VMS components (for example, the MCR and AME interfaces)
- Operating system software for the CT (Computing Terminal) Program (see Section 10 of this chapter)

2.1.5 VMS-RMS
Manager: Frank Hassett (ZK1-2/E16, 264-8610)

The VMS-RMS group develops software for specific VMS functions relating to record management, data integrity, and availability. They provide RMS-32, the Record Management System shipped as a part of VMS. The group also provides the portion of VMS responsible for the integrity and availability of data and processes.

RMS-32 Activity: RMS-32, an integral part of the VMS product, provides sequential, relative, and indexed file operations for programs written in any supported language. The RMS-32 group produces continued releases of RMS-32 in response to growing customer needs, as well as the needs of Digital's layered products. A release may have as many as 100 requests for added functionality.

A typical release cycle is 18 months, and, in addition to design, includes performance measurement, documentation, and extensive field testing. The quality of the product is top priority, and all designers are responsible for fixing "bugs" for periodic maintenance updates betweeen major releases.

System Availability and Integrity: This group develops VMS software enabling execution of high-availability applications on VAX/VMS systems. They also help define how the nucleus of VMS and RMS needs to support these applications.

The major area of RMS functionality needed for high-availability systems is a journalling capability. This and other RMS needs are so closely tied to other system availability requirements that this specific RMS work will be done within the System Availability group.

2.2 CENTRAL COMMERCIAL ENGINEERING
Manager: Bob Daley (MK1-1/E06, 264-6183)

The Central Commercial Engineering Group (CCEG) develops and supports technology- and market-based products. CCEG's technology-based role involves Data Base, Transaction Processing, and Information Management products for the general data processing market. This engineering effort includes products such as Datatrieve, DBMS, CATS, TPSS, and the Common Data Dictionary (CDD). CCEG's market-oriented role is to enhance and engineer for Digital's commercial marketplace. Market-oriented engineering includes the development and support of products such as RSTS/E, the DEC DATASYSTEM series of packaged systems, TYPESET-11, and VAX-11 DECset.

2.2.1 CCEG Architecture and Technology
Manager: Bruce E. Parker (MK1-2/C02, 264-6956)

This department consists of three major areas of responsibility: Architecture and Technology, Commercial Systems Evaluation, and the Engineering Network group.

Architecture and Technology ensures an integrated architecture and advanced development effort across the CCEG development organization. The program's thrust is to ensure that all CCEG technology, advanced development, and architecture efforts are properly focused to support related activities within Software Engineering, and to ensure consistency with the overall Central Engineering product development strategy.

Commercial Systems Evaluation (CSE) provides all levels of systems evaluation to the CCEG and Office Systems Engineering groups, including performance measurement and analysis, product assurance, and cross-project studies. CSE acts as the CCEG representative to the other performance groups, and is responsible for CCEG and general commercial product positioning, workload standardization, and special tool development. Consulting support is also provided to Marketing, Product Management, and to those product lines involved with CCEG products.

The *Engineering Network* group maintains the links in the Digital Engineering Network. The Engineering Network ties Digital's engineering groups together by computer, to provide rapid transmission of data. The Network group provides topology planning, problem resolution, and emergency assistance to the many facilities tied into the Network. Contact them to get your computer into the Network.

2.2.2 CCEG Project Management
Manager: John T. Morgan (MK1-2/AO8, 264-5672)

CCEG Project Management has three major sections:

Project Management supports CCEG's commitments made for functionality, schedule, and cost of products. They support Bill Johnson's goal of Digital's worldwide recognition as the leader in software quality by FY85.

Commercial Systems Evaluation evaluates the system performance of CCEG products in support of development projects, supplies product assurance for CCEG systems and layered products, and performs product positioning studies for Engineering groups.

Resource Development and Project Services provides support services and management tools for project management and CCEG resource planning and tracking. Services include capital planning and acquisition and CCEG project reporting (Beige and Yellow Books) to Engineering. Management tools include: administrative tools for decentralized management decision-making and project control; employee skills and resource skills development related to project management; risk management; and quality implementation.

2.2.3 CCEG Product Management

Manager: John Anderson (MK1-2/D03, 264-7783)

The Commercial Product Management group defines the requirements of commercial software products throughout Digital. They introduce these products to the market, and coordinate the products throughout their life cycles. Product requirement issues include service, support, promotion, distribution pricing, and other market-sensitive parameters, as well as functional capabilities. Group responsibilities include RSTS/E, CATS/TPSS, Information Management, and Commercial Languages.

CCEG Product Management offers the engineer a central place to come for information and support for product development.

2.2.4 CCEG Publications and Services

Manager: Gerry Broyles (MK1-2/H03, 264-8790)

This group provides support functions for the Commercial Engineering Groups at Merrimack. These functions include documentation, typesetting, publishing, computer operations, library, space and facilities, and other necessary areas of support.

2.2.4.1 Commercial Engineering Documentation

Managers: Bill James (MK1-2/H03, 264-6772)
Sandy Kaplan (MK1-2/H03, 264-6919)

Commercial Engineering Documentation (CED) plans and writes user documentation for CCEG, Commercial Languages, and commercial product lines. Contact their writers and editors with your documentation questions about these product areas:

- Information Management (DBMS, DATATRIEVE, CDD, RDMS)
- CATS and TPSS
- RSTS/E
- Commercial Languages and Utilities (BASIC, COBOL, RTL, SORT, EDT)
- DECset (In-house typesetting system)

CED also does ongoing research into customer and market requirements, competitive literature, and user reaction to documentation.

2.2.4.2 Office Products Documentation

Manager: Fran Ladd (MK1-2/E06, 264-5834)

This group provides high-quality documentation sets to accompany small office computers. Their writers work with development program teams, which include project engineers and managers, product managers from the Product Lines and Engineering, CSSE, SDC, and others.

Currently, the group writes for Word Processing (WPS-8/Diskette and Disk: 78, 80, 200 Series and DECmate) and OFIS (OFIS/Word Processing; DECmail; OFIS Base Machine, Message Router, Digicalc). In addition, the group takes on writing projects for other product lines with similar products.

This group is concerned with providing manuals for the office end-user environment. In this environment, the customer may be responsible for installing the equipment and learning how to run and maintain it. This represents a new challenge for training, reference, and support documentation.

2.2.4.3 Creative Typeset and Publishing

Manager: Ginger Landry (MK1-1/H08, 264-6873)

The only full-service in-house publishing group in Merrimack, Creative Typeset and Publication (CTP) can handle virtually any typesetting and design need, from microfiche headers, posters, newsletters, and promotional brochures to multi-volume technical manuals. The group can convert various source files (WPS, RNO, or DOC) to typeset copy, using Digital's TMS-11 system and a Mergenthaler Linotron 202. CTP also offers proofreading, production editing, and complete art services, including layout, pasteup, graphic design, technical illustration, photography and photostat services (halftones, screened shots, reversals, transparencies, overheads, and slides). In addition, CTP handles all printing arrangements.

2.2.4.4. Computer Services and Facilities

Manager: John Shoudel (MK1-1/K09, 264-5685)

Computer Services and Facilities (CS&F) provides several service functions for Software and Hardware Engineering in Merrimack. These services include Computer Operations, Operating Systems Support, Order Processing, and Office and Lab Space Administration. CS&F also provides Merrimack with an Engineering Network focus, as well as Data Communications support and Corporate Stockroom 393 services.

2.2.5 Commercial Systems Engineering

Manager: Brian Fitzgerald (MK1-1/B07, 264-5553)

Commercial Systems Engineering develops hardware products for CCEG and the Merrimack product lines. They design computer systems and related equipment for general purpose commercial, word processing, and office applications. Commercial Systems Engineering also provides diagnostic engineering, drafting, and printed circuit design services for all hardware engineering departments in Merrimack, and can provide similar support for other organizations in southern New Hampshire.

Commercial Systems Engineering consists of four departments:

2.2.5.1 Datasystem Hardware Engineering

Manager: Jim Milton (MK1-2/H32, 264-6117)

Datasystem Hardware Engineering designs, develops and supports PDP-11 and VAX-11 hardware computer systems, and related commercial products. They develop common hardware subsystem configurations around standard corporate products, and integrate them with appropriate software packages to produce complete systems suitable for commercial data processing operations. They presently emphasize novice-installable systems, humanized diagnostics, and installation and repair manuals to reduce the costs of ownership.

Datasystem Hardware Engineering is also a Central Engineering resource for electrical or mechanical design and development work at Digital's southern New Hampshire locations.

2.2.5.2 Office Systems Hardware Engineering
Manager: Bob Gray (MK1-1/J14, 264-5874)

Office Systems Hardware Engineering designs, develops, and supports total computer systems for word processing and office system applications. These market-specific products may be developed by modifying standard corporate products or by buying suitable products from outside vendors.

Office Systems Hardware Engineering also provides system product assurance for office products, to ensure installability and maintainability.

2.2.5.3 Diagnostic Engineering
Manager: Bob Misner (MK1-1/L38, 264-5949)

Diagnostic Engineering develops diagnostic programs for Merrimack hardware design groups. Their primary efforts support Communication Engineering's options and network testing. Diagnostic Engineering also supports the Word Processing, Graphic Arts, Telecommunications, Traditional, and Government Systems product lines.

Diagnostic Engineering provides design and implementation assistance on all Reliability, Availability, and Maintainability (RAMP) aspects of systems and units. They work with software and hardware groups to help set and meet RAMP goals in the commercial environment. This work requires the department to provide a system-oriented overview and to be concerned with the human engineering of components critical to meeting RAMP objectives.

2.2.5.4 Merrimack Engineering Services
Manager: Robert Tremblay (MK1-1/B07, 264-5442)

Merrimack Engineering Services provides drafting, printed circuit design, engineering change orders (ECOs), engineering document service, CAD (computer-aided design) and computer services for Merrimack and other southern New Hampshire engineering groups. For more discussion of these services, see Section 1.3.4 of Chapter 6 on Engineering Services.

2.2.6 Information Management
Manager: Fred Howell (MK1/J12, 264-6023)

This group is responsible for information management and transaction processing systems, and related products that support commercial applications. They develop software products and aid other engineering groups with strategy and program management.

The group's two major programs are:

- Corporate Information Management Strategy and related products
- Transaction and interactive information management processing systems for medium-large business systems

The Information Management group is responsible for such specific products as:

- CDD (Common Data Dictionary)
- DBMS (CODASYL Data Base Management System)
- TPSS (Transaction Processing Subsystem)
- RDMS (Relational Data Management System)
- CATS (Commercial Applications Terminal Support)

Contact the group on any of the following topics:

- Current or planned capabilities of the products listed above
- Commercial data processing capabilities of VAX and VAX/VMS systems
- Corporate Information Management Strategy
- Corporate transaction and interactive Information Management systems

The Information Management group can provide you with project plans, functional specifications, technical strategy documents, and related materials.

2.2.7 Text and Media Systems

Manager: Bob Mitchell (MK1-2/C8, 264-6168)

Text and Media Systems develops systems and applications for interactive text management processing and media systems.

DECset Software Engineering develops future product software for the DECset publishing system, and builds a capability to perform current customer software engineering for DECset.

Media Industries Current Products Engineering promotes and maintains customer satisfaction for TMS-11 systems, by providing post-sales software support and product enhancements.

Media Industries New Products Engineering develops new software products for media industries on the PDP-11 and the VAX family of hardware, and ensures that quality is an integral part of each new product.

2.2.8 RSTS/E Systems Development

Manager: Pam Saloky (MK1-2/L2, 264-7776)

RSTS/E Systems Development engineers and maintains RSTS/E, a timesharing system for general commercial application, and DECnet/E, a software package enabling RSTS/E systems to communicate with other Digital systems.

Contact RSTS/E Systems Development to discuss the products listed above, hardware support for RSTS/E, and engineering and business strategies for the small business marketplace. They can provide you with project plans, functional specifications, system plans, and related materials.

2.3 10/20 AND SMALL SYSTEMS AND CORPORATE LANGUAGES

Manager: Dom LaCava (MR1-2/L8, 231-5062)

This organization consists 10/20 Systems, Small Systems Software, and Corporate Languages.

The *10/20 Systems* group develops all software for the DECsystem-10 and DECSYSTEM 20, with the exception of network software. They also have a major advanced development program in profession-based systems. The 10/20 Systems group is divided into Operating Systems, Languages, Publications, Data Management, and Program/Quality Management.

The *Small Systems Software* group develops the RT-11 operating system, which is Digital's low-end PDP-11 operating system and its highest volume software product. They produce the Forms Management System's layered forms filling software, which runs on most of Digital's operating systems. They also work on chip and board software development systems, graphics, and human factors advanced development.

The *Corporate Languages* group develops virtually all languages for Digital's computers, from the PDP-11 up through the largest DECsystem-10s and DECSYSTEM 20s. The Corporate Languages group is divided into Technical Languages and Commercial Languages.

2.3.1 Technical Languages

Manager: Norma Abel (ZK1-3/D40, 264-8138)

The Technical Languages group develops technical language compilers for the PDP-11, VAX, and DECSYSTEM 20; these languages include FORTRAN, APL, and PL/1. The group is also responsible for the VAX debugger and for language-related object-time systems for PDP-11 technical languages. They handle the set maintenance of those products on the PDP-11 and VAX.

2.3.2 Commercial Languages

Manager: Jeffrey Rudy (MK1-2/J5, 264-6680)

This group develops and maintains language processors and utilities for PDP-11 and VAX-11 systems. The languages have industry-wide appeal for commercial applications, although they are not limited to that area. Such languages include COBOL and the extended DEC BASIC products.

Commercial Languages also develops key system utilities, including SORT packages, language translators, the DEC Standard Editor, and the VAX/VMS Common Run Time Library. Members of the group hold positions on numerous national and company standard committees, and participate in software architecture activities.

Contact this group on questions or issues related to the products listed above. Commercial Languages can provide additional information on VAX Language Environment Standards, CODASYL COBOL, ANSI COBOL and BASIC or Command Language committees, and DEC Standards for Editors, BASIC, or COBOL.

2.3.3 10/20 Systems Software

Manager: Ron Criss (MR1-2/L8, 231-5243)

The 10/20 Software Systems group consists of the Operating Systems Group and the Data and Systems Management Group.

The Operating Systems Group, managed by Peter Hurley (MR1-2/L10, 231-6183), includes the following organizations:

- The *Monitor Group*, supervised by Sumner Blount (MR1/L10, 231-6328), is responsible for TOPS-10 and TOPS-20 monitors.

- The *Suvax Group*, supervised by Larry Samberg (MR1-2/110, 231-6338), is responsible for SUVAX software advanced development.

- The *Coexistence Group*, supervised by Fred Engel (MR1-2/L10, 231-6871), is directing the 32/36 coexistence work.

The Data and Systems Management Group is managed by Dave Braithwaite (MR1-2/L14, 231-4400). It consists of these teams:

- The *Data Management Group*, supervised by Bill Harrelson (MR1-2/L14, 231-5180), is responsible for the software development of DBMS-10/20, RMS, FORTRAN and COBOL.

- The *GALAXY team*, supervised by Sue Godsell (MR1-2/L14, 231-6338), is responsible for the BATCH, spooling, and network utilities for DECsystem-10 and DECSYSTEM 20 products.

- The *Release Engineering* team, supervised by Magee Symonds (MR1-2/L14, 231-4498), prepares DECsystem-10 and DECSYSTEM 20 software for release to the Software Distribution Center (SDC). The team also ensures that components for 10/20 software products are complete and consistent for general release.

2.3.4 Small Base Systems Software

Manager: Gil Steil (ML5-5/E76, 223-5150)

The Small Base Systems Software group specifies, designs, implements, tests, and supports small real-time operating systems, personal computer software, intelligent terminal software, chip and board software, BASIC and PASCAL language implementations, and special, directly-funded software products.

2.4 SOFTWARE PUBLICATIONS

Managers: Armen Varteressian (ZK1-3/J35, 264-8344)
Norm Brimhall (TW/E07, 264-2275)
Gerry Broyles (MK1-2/H03, 264-8970)
Kathy Richer (MR1-2/E37, 231-6581)

Software Publications is located in Tewksbury (Distributed and Mid-Range Systems), Marlboro (10/20 Systems), Merrimack (Commercial Engineering), and Nashua (Base Systems).

These writers, editors, and production people generate and maintain software manuals for customers at all levels of experience. Collectively their responsibilities include the planning, organization, completeness, accuracy, appropriateness, user orientation, and appearance of software publications.

To effectively design a software manual, groups gather information from software and hardware engineering, the product lines, software quality management, Software Services training, DECUS, and visits to customer sites.

These groups maintain a close professional relationship with other document-producing groups within Digital to promote compatibility, consistency, and uniformity in software and hardware manuals.

2.5 APPLICATION SYSTEMS GROUP

Manager: Ollie Stone (ML21-3/E87, 223-6617)

The Application Systems group is responsible for application systems development and strategy within Central Engineering. In addition, they will provide contract hardware and software engineering and technical writing for any group within Digital.

Application Systems is composed of Application Systems Development and Application Technology.

2.5.1 Application Systems Development

Manager: Ollie Stone (ML21-3/E87, 223-6617)

Application Systems Development (ASD) designs and implements hardware and software systems for internal Digital organizations and product line groups. Application Systems is a systems engineering resource that provides software and hardware engineering, technical writing, "bug" fixing, consultation, and other related services.

The group's systems represent major investments in hardware and software development, requiring high availability and reliability. To ensure the necessary predictability of costs and schedules, Application Systems follows a written agreement on project functionality.

Group projects are usually based on VMS, RSTS, or RSX, but many projects use other operating systems and a wide variety of languages.

In addition to Technical Systems (2.5.1.1), three other teams provide services for Digital organizations:

Group	*Manager*
ASD North	S.S. Bajwa (ZK1-2/D13, 264-8578)
VAX Technical Systems	Steve Hargrave (ML21-3/E87, 223-4438)
ASD Technical Writing	Martha Dufresne (MK1-1/A6, 264-7488)

2.5.1.1 Technical Systems

Manager: Don Wilson (ML21-3/E87, 223-5806)

This group combines hardware and software engineering expertise to develop technical application systems, real-time applications, custom hardware, and system consulting.

The systems and products developed by this group are done at the request of internal organizations, including Central Engineering, Field Service, Manufacturing, and Product Lines.

Software Engineering capabilities and expertise include all PDP-11 operating systems, VAX/VMS, most languages, and firmware development. Hardware Engineering capabilities and expertise include digital and analog development, and system design and qualification.

Contact this group at the concept stage of your project if you need their assistance.

2.5.1.2 Internal Special Systems

Manager: Ollie Stone (ML21-3/E87, 223-6617)

Internal Special Systems (ISS) provides services to organizations throughout Digital in consulting on and developing customized application systems. These applications are on-line and real-time, ranging from engineering to business, industrial, financial, and medical. Data base systems developed include order processing, material tracking, bill of material/product price merging, corporate switch, and contract administration systems. Real-time systems include 1981 Digital Network Control and FCC (Federal Communications Commission) Measurement Control.

To achieve high quality results, ISS uses a written and orderly development process for its projects. These processes include:

- Project Plan
- Functional Specification Outline
- Design Specification Outline
- Coding Conventions
- Software Quality Assurance Release Procedures
- Project Monitoring Tools
- Software Installation, Customer Training, and Support

Contact this group for assistance in consulting and developing application systems software to handle your business needs.

2.5.2 Application Technology
Manager: Cliff Neer (MK1-2/K32, 264-7634)

This group develops commercial application systems based on a flexible application architecture.

2.6 SOFTWARE ARCHITECTURE AND TOOLS
Manager: Bill Keating (ZK1-3/J10, 264-8315)

This group is responsible for the management and coordination of Software Architecture. They help administer architectural processes and provide technical leadership to resolve key strategic and implementation issues within Software Development. They also coordinate various software advanced development activities.

Contact the group for solutions to major software architectural problems. The group will also help you understand the process in place, and take suggestions relative to software advanced development. Contact them with questions or suggestions about tools and methods available at Digital.

2.6.1 Hardware/Software Coordination
Manager: Jim Kapadia (ZK1-3/J10, 264-8319)

The Hardware/Software Coordination group is primarily responsible for coordination and planning between hardware and software groups. They try to minimize disjointed efforts between the two by facilitating and influencing compatibility among plans, technology, strategies, and processes. They also help resolve issues common to both hardware and software and, over the long range, help provide needed decisions for smooth and efficient cooperation between the two.

The group publishes the *Hardware-Software Planning Matrix* on a regular basis. The *Matrix* helps the planning process between the hardware products and software systems.

Contact this group when there is an inconsistency between hardware and software plans (for example, release dates, funding, support), products (for example, design, architecture), and strategies. The group will help resolve the issues by providing proper visibility and by directing work to appropriate functions (like Software Planning, Systems Architecture, Product Management). An engineer should contact this group when hardware-software issues are detected that relate to his or her specific efforts, but are broader in impact and hence need a continuing overall focus.

2.6.2 Software Methods And Tools
Manager: Bill Segal (ZK1-3/B21, 264-8049)

This group develops and supports tools for software engineers with a primary focus on increasing productivity and software quality and decreasing software life-cycle costs. They also promote the use of state-of-the-art software engineering methods where applicable within Digital.

The Methods and Tools group will provide specific software tools along with documentation, training, and support as needed. The group is interested in consulting on any area within their expertise such as implementation languages, debuggers, text processors, library control systems, intelligent workstations, and software methodology. They also publish the Software Tools Newsletter.

Contact the group for information or support on any of the following:

- BLISS Compilers and Utilities
- DEC Standard RUNOFF
- Debuggers for VAX and PDP-11
- DIAMOND (Performance Measurement System)
- Electronic Mail System (DEC MAIL)
- Magnetic Tape Interchange
- Microfiche Utilities
- Documentation Tools
- Source Library Manager (STEP)
- Transportable Software
- Software Methodology
- BLISS and MACRO-11/780 Coding Conventions
- Test Library and Verification System (TSV)

2.6.3 Software and Systems Architectural Management
Manager: Alex Conn (ZK1-3/J10, 264-8320)

This group assists in the integration of architectures within Software Engineering and helps coordinate the development of key strategies, interfaces, and functionality for these architectures. The group is particularly concerned with the establishment of effective processes for managing these architectures.

Contact this group if there are major discrepancies or unclear strategies within or between architectures, or whenever there appears to be insufficient coordination between groups. They help to resolve issues on a global level, and do not deal with specific problems within a product that do not affect other groups or products. This group will also assist in bringing significant complex cross-component architectural issues before SARA (Systems Architecture Review and Approval Group) for resolution. (See 3.5 of this chapter for a description of SARA.)

2.7 OFFICE SYSTEMS PROGRAM
Manager: Bruce Stewart (MK1-2/E6, 264-7510)

The Office Systems Program develops office information systems products. Their products include word processing systems, electronic mail, letter-quality printers, intelligent copiers, file servers, administrative subsystems, voice subsystems, and graphics. Through buy-outs and in-house development, they add hardware and software to existing Digital products to create these capabilities. They also provide systems integration for Office Systems products.

3 SYSTEMS, ARCHITECTURE, AND TECHNOLOGY

Manager: Sam Fuller (ML2-2/H33, 223-4562)

Systems, Architecture, and Technology (SA&T) provides leadership in the basic technical areas and processes necessary for the development of Digital's future products. In particular, SA&T is responsible for those functions that require a central focus: research, architecture, standards, the positioning of present and future products, and technology strategies. They also manage those technical activities that, because of their cross-product or cross-organizational implications, unusual technical expertise requirements, or newness to Digital, are best handled by a central group.

3.1 Corporate Research

Manager: Richard Eckhouse, acting (HL2-3/N04, 225-5800)

Corporate Research is responsible for providing Digital with the knowledge and expertise needed to develop new products, technologies, processes or businesses that we believe will be critical 5 to 10 years from now, by performing industrial research work in areas of high risk and leverage. The group focuses on a few high-priority technical areas, and does not do research in all the technologies associated with our business. Corporate Research also provides information services through Corporate Information and Library Services. Ongoing dialogues and joint projects ensure that Corporate Research learns the needs of and exchanges ideas with other groups.

The following sections describe the programs, skill centers, and information services functions of Corporate Research.

3.1.1 Manufacturing Automation

Manager: Tom Williams (HL2-3/N04, 225-5804)

The Manufacturing Automation program, in conjunction with Manufacturing, explores technologies for improving Digital's manufacturing capabilities. The Design/Manufacturing Automation Steering group coordinates the program.

The program is currently investigating robotics and computer vision, with emphasis on materials handling, assembly, test, and inspection. They are also researching the problems of distributing information in the manufacturing environment.

The Manufacturing Automation Laboratory on ML3-5 supports this program.

3.1.2 Exploratory Research

Manager: Steve Lipner (HL2-3/M08, 225-5805)

The Exploratory Research program examines fundamental technical issues that may have high technical risk, but also show high potential market value to Digital. Current projects include image processing, systems security, visual fatigue, high-performance computation, numerical analysis, and a microcoded math library.

The results of these projects may be used by current development groups. Once there is a basic understanding of the technical issues and potential pay-off, Exploratory Research projects may become the basis of new programs.

3.1.3 Integrated Systems and Terminals
Manager: Steve Lipner (HL2-3/M08, 225-5805)

This skill center explores architectural and implementation issues primarily relevant to low-end systems. They attempt to exploit Digital's proprietary LSI components, as well as utilizing industry-stored and LSI/VLSI devices. Current research includes:

- Integrated System Architecture
- Component VAX systems
- Generalized Image Architecture
- Low-end disk controller architectures

The group also maintains a growing reference library on internal and external systems and module designs.

3.1.4 Multiprocessing and Local Area Networks
Manager: Fernando C. Colon Osorio (HL1-2/E47, 225-4738)

This skill center researches multiprocessing, area network design and methodology, and distributed processing. They believe that, by the late 1980s, multiprocessing systems will replace single processor systems in all major areas of computing. For this reason, they concentrate their research in the following areas:

- *Local Area Networks*: Designing cost-effective local area networks for the low-end user. Alternative medium-size technologies for the local area networks of the late 1980s.
- *Interconnect Architectures*: Designing and implementing architectures to support distributed processing applications. Providing a network services interface to applications running on the local area network.
- *Multiprocessing*: Designing and implementing operating systems that support distributed functions in a multiple processor environment.

In addition, this skill center is researching numerical analysis, such as high accuracy microcoded mathematical and floating point computation (including Digital's standardization effort).

3.1.5 Distributed Software Architecture Research
Manager: Frank Germano, Jr. (ML3-4/T50, 223-7581)

This skill center researches the design and implementation of distributed software systems. Demonstrating concepts by using prototypes is a major focus. Projects are underway or planned on the technical problems of profession-based systems and distributed transaction systems. Major current projects include constructing a distributed concurrency control algorithms test bed, studying alternative distributed data base system architectures, prototype construction of a network operating environment for profession-based systems, and the evaluation of directory architectures.

3.1.6 Languages and Applications

Manager: Ike Nassi (ML3-4/T50, 223-4487)

This skill center is conducting research in languages and applications. They believe that applications software will play an important role in Digital's future. For this reason, the group's goal is to develop expertise and provide tools in this field. Currently, the group's projects are divided into four areas:

- Software Methodology (SEER, STEP-software maintenance tool)
- Languages (Ada, translator tools such as PAT)
- Data Bases (semantic models, data base machines, interfaces QBF, data base languages)
- Professional workstations

The group's current strengths are in the areas of languages, tools, and systems. They would be happy to provide consultation, tutorials, or other forms of assistance in these areas.

3.1.7 Integrated Profession-Based Systems Program

Manager: Rick Peebles (HL3-2/M08, 225-5802)

This research program is developing a prototype personal computer network for the professional. They are building an experimental system, called the Liberty Net, that they plan to use for their own daily work. This lets them tackle both design for future computing styles and evolution to that future from today's world. The Liberty Net will include a variety of computers including:

- Ada machines running on VAX processors. (Ada machines are computers where the lowest available interface is the Ada programming language.)
- VAX/VMS group machines that provide access to VMS software tools, the Engineering Network, dial-up phone lines, and historical files.
- Smalltalk machines (Xerox Smalltalk-80) running on 11/23B processors.
- Data servers for archiving, and printer servers for hardcopy output from personal computers.

This program is one of the principal efforts in Digital to understand the personal computer network environment of the future, including the roles of VLSI central processors in the PDP-11 and the VAX. For further information, contact Rick Peebles (ML3-2/E41, 223-8817).

3.1.8 External Research

Manager: Dieter Huttenberger (HL3-2/N04, 225-5805)

This group identifies critical corporate research needs and develops these research projects for Digital in cooperation with universities and research institutions. There is a mutually beneficial transfer of technology and processes, and the outside institutions also benefit from access to Digital equipment.

Each project has a Digital sponsor. The sponsor submits and describes, estimates, and justifies the cost of the proposed research. All projects must be evaluated and approved by the Research Review Board. Approved projects are reviewed annually.

3.1.9 Planning Research and Operations
Manager: Jan Jaferian (HL2-3/N04, 225-5801)

This group is divided into two major functions:

Planning facilitates Corporate Research's planning and allocation of human and fiscal resources. The output of the Planning group includes the Beige and Yellow books, internal program and project plans, and various market analyses and technical reports.

- *Market Research* analyzes the potential business success of research projects, provides functional product specifications, and maintains a competitive data base.

- *Technology Tracking* evaluates specific technologies and processes in view of make/buy decisions and competitive strategies.

- *Human Factors* provides aid in the design and specification of user-oriented products.

Operations is responsible for the general administration of Corporate Research, and maintains the various laboratories that support its research and computing needs.

3.1.10 Corporate Information and Library Services
Manager: Ralph Coffman (ML4-3/A20, 223-6465)

Corporate Information and Library Services (CILS) is an information processing center located in the Corporate Library, Maynard. It works cooperatively with the 11 information centers on the Digital Library Network. For more information on CILS, see the description of the Digital Library Network, Chapter 10, Section 1.

3.2 VAX-11 AND PDP-11 SYSTEMS ARCHITECTURE
Manager: Bill Strecker (TW/B05, 247-2130)

This group is responsible for the management of key Digital architectures. Management includes the functions of architecture definition, specification, maintenance, and evolution. The key architectures currently managed include the PDP-11 and the VAX-11 hardware architectures, the emerging I/O architecture, and the emerging high-availability architecture.

The group resolves ambiguities or errors in architecture specifications (for example, the PDP-11 Processor Handbook, the VAX-11 Architecture Handbook, and the VAX-11 SRM). The group handles requests for changes to existing architectures. Additionally, it assesses the architectural impact of new hardware structures (for example, bus structures).

Contact the group when you need architecture changes, clarifications, or architecture usage data (instruction statistics) or when you think new architectures should be brought under formal architecture management.

3.3 SOFTWARE AND ARCHITECTURE STANDARDS

Manager: Gary Robinson (ML12-3/E51, 223-4094)

Software and Architecture Standards (SAS) manages Digital's representation on standards committees outside of the corporation. The Standards manager defines guidelines for delegates and budgets for travel costs and dues to standards organizations. Delegates are usually chosen from development organizations by the Standards manager and the appropriate engineering manager.

Contact SAS for information about the standards process, or to join one of the committees. You can also join review lists to contribute Digital's comments and votes. Organizations covered include:

ANSI	American National Standards Institute
CODASYL	Conference on Data Systems Languages
CCITT	International Telecommunications Organization
ECMA	European Computer Manufacturer's Association
EIA	Electronic Industries Association
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Standards Organization
JEDEC	Joint Electronic Devices Engineering Council
NBS	National Bureau of Standards

SAS does not manage participation in standards committees concerned with environmental and safety issues (acoustics, electrical safety, EMI, RFI). These committees are generally sponsored by CBEMA (Computer and Business Equipment Manufacturers Association) or ECMA. Participation is managed by Hardware Design Assurance. Likewise, standards committees on micrographics issues are the responsibility of Engineering Services.

A second major function of SAS is sponsoring development and maintenance of Digital Standards in the areas of software, I/O architecture, networks, media, office systems, keyboards, and user interface to Digital products.

The following standing committees are maintained to develop standards and review product specifications: BASIC, COBOL, PASCAL, Keyboard Arrangements, VAX Languages, and DECnet Architecture.

SAS can supply you with these documents and services:

- *The World of EDP Standards*: a non-technical description of the activities and relationships of the many organizations involved in national, regional, and international standards for computers and information processing.

- *Computer Industry Standards Summary*: abstracts of all computer-related standards published by ANSI, FIPS Federal Information Processing Standards), CCITT, IEEE, ECMA, and ISO.

- *Standards Libraries*: a large library of computer-related standards based in Maynard. Collections of ANSI, FIPS, and ECMA standards are located in the corporate libraries of Marlboro, Tewksbury, Merrimack, Spitbrook Road, and Reading, England.

- *Interest Lists*: list of Digital employees qualified and interested in commenting on standards subjects. Can be used as a source of names for Design Reviews.

- *Consultation Service*: Consultation on interpretation of industry standards, standards processes, and politics. Assistance in developing text to describe standards conformance in user manuals or Software Product Descriptions (SPDs).

Contact Software and Architecture Standards during the earliest phases of your project to determine what Digital and external standards are applicable. They would like to review all Project Plans and any functional specifications where conformance to Standards is an important part of product definition. SAS can tell you about proposed standards that may become mandatory before your product is shipped.

Contact SAS for review of the exact text of Software Product Description (SPDs) or user manuals that describe standards conformance. Because of the legal impact of standards conformance it is important that the text be accurate. Phrases like "conform", "compatible with", "based on", or "subject to" can have very different legal meanings.

Contact SAS if you feel a project is not following applicable Digital or industry standards. They do not enforce standards or grant waivers, but they can make sure your issue gets the proper visibility.

Software and Architecture Standards would like to be notified if you hear of new standards committees that Digital should join.

3.4 SYSTEMS PERFORMANCE ANALYSIS

Manager: Terry Potter (HL2-3/N11, 225-6061)

This group provides performance analysis for the Technical Director (manager of Systems Architecture and Technology), and for other organizations within Digital, on a charge-back basis (primarily Engineering development groups). Engineering support focuses on analyzing architectural/design alternatives, to determine their impact on the system's performance, and product positioning, to determine the cost performance of the system.

They also develop methodologies and tools for loading systems and for analyzing, measuring, and predicting system performance.

The group's performance analysts are skilled in modeling, measurement, tool development, and analysis. Contact them whenever you need these skills applied to problems in the above areas.

3.4.1 16/32/36-Bit Systems

Manager: Paul Nelson (HL2-3/C09, 225-5905)

This group will provide systems positioning, analysis, studies, and information for 16-, 32-, and 36-bit systems, and intelligent terminals and competitive systems.

They can assist you in design support, system CPU modeling, engineering evaluation of prototypes, and product positioning.

They can perform analytical and simulation modeling and system measurement including hardware monitoring and single- and multi-user system benchmarks.

Contact them if you have a performance/design related problem that their techniques and skills can help you solve. Requests for special studies require funding, but current information is available at no charge.

3.4.2 Architectures, Networks, and Storage
Manager: Linda Wright (HL2-3/C09, 225-5940)

Architecture, Networks, and Storage provides performance analysis support, primarily to architecture, advanced development, and development groups. They work in the following areas:

- Future system architectures (for example, object-based architectures)
- Local area networks
- Network interconnects
- Network protocols
- Communications subsystems
- Storage subsystems (including data base machines)
- Human interfaces

Contact this group if you want to predict the performance impact of design alternatives in these areas.

3.4.3 Loads, Drivers, and Models
Manager: Rick Fadden (HL2-3/C90, 225-5970)

This group develops methods and tools for representing system workloads, applying workloads to systems (for example, Remote Terminal Emulation such as SIM11), and modeling system behavior under varying load conditions.

Modeling tools can provide the basis for system design analysis, predictive product positioning, and system performance management, including sizing new systems and planning for the growth of current ones. This group develops the SIM11 remote terminal emulator, the SORT (System Organization Review Tool) and SPAM (System Performance Analysis Model) modeling tools, and workload analysis and performance management tools.

3.4.4 Performance Laboratory
Manager: Dave Arnold (HL2-3/C09, 225-5980)

The Performance Laboratory is a hardware/software environment for the completion of performance work. There are two sections of the Performance Laboratory. The Computer Systems Laboratory supports and maintains current Digital products; the Competitive Analysis Laboratory supports and maintains a selection of competitive systems.

The Performance Laboratory group aims to be a cost-effective resource for the Digital performance community. All computer systems in all Systems Performance Analysis labs can be scheduled for use. Time can be scheduled for users outside the performance community as well. Please contact this group if they can help in making stand-alone systems available to you.

3.5 PLANS AND OPERATIONS
Manager: Bill Svirsky (HL2-3/N11, 225-6073)

Plans and Operations is responsible for developing planning and asset management processes used by other Systems, Architecture, and Technology (SA&T) groups. They manage SA&T's facility and space planning and the SA&T business calendar, and interface with other planning groups within Engineering. They also provide functional management for SA&T laboratories.

Plans and Operations provides adminstrative support to these standing committees:

- Research and Advanced Development Committee (RAD)

This committee consists of key senior technical contributors representing all aspects of engineering. They review advanced development plans and projects on a regular basis. They encourage specific advanced development activities by soliciting proposals and funding those that meet their criteria, based on merit, long-term corporate strategy, and innovation.

- Technology Management Committee (TMC)

This committee consists of advanced development managers. They primarily focus on long-range strategic planning, and the integration of plans with the corporate product development strategy.

- Systems Architecture Review and Approval Group (SARA)

The Systems Architecture Review and Approval group (SARA) is an umbrella organization composed of architects representing major component groups (of products) within Central Engineering. Its fundamental purpose is to recognize, study, and resolve major cross-component architectural issues, by establishing appropriate processes and task groups. In addition, SARA serves as a forum for architectural issues of major corporate impact for which an alternate architectural forum is not available. SARA is not intended to centralize the architectural function. Rather, it ensures and determines that adequate mechanisms are in place to achieve timely resolution of issues, whether within the component architecture or in the interfacing with other components.

Contact SARA through Alex Conn (ZK1-3/J10, 264-8320) with your comments and questions about major architectural issues that cannot or will not otherwise be adequately addressed by existing cross-component architectural groups.

4 LSI (LARGE SCALE INTEGRATION) MANUFACTURING AND ENGINEERING

Manager: Jim Cudmore (ML1-5/E30, 223-2393)

4.1 SEMICONDUCTOR ENGINEERING GROUP

Manager: Steve Teicher (HL1-1/R08, 225-4900)

The Semiconductor Engineering group (SEG) drives the use of semiconductor technology in Digital products, because the ability to develop and produce silicon-based systems is critical to the Corporation's long-range plans. To do this, SEG offers a variety of services that insure the development, implementation and support of product-specific and standard LSI/VLSI chips. The following groups comprise Semiconductor Engineering. Contact them when you have a question about their area of expertise.

4.1.1 Architecturally-Focused Product Development

Manager: Duane Dickhut (HL1-1/S08, 225-4941)

This group develops the chips and subsystems that are most closely related to Corporate-maintained computer architectures. Their products include microprocessors and their subsystems, to be used in a range of product applications.

4.1.2 Program-Specific Product Development
Manager: Mark Menezes (HL1-1/R11, 225-7907)

This group designs MOS and bipolar LSI chips that are not commercially available, but are required for use in Digital products. Contact them when you need custom-designed LSI devices and technology.

4.1.2.1 Mass Storage and Peripherals Circuit Design
Manager: Art Cappon (HL1-2/Q10, 225-4897)

Mass Storage and Peripherals Circuit Design (MS&P) supports Digital's custom integrated circuit needs from system conception through circuit implementation. They apply appropriate process technologies to find total system solutions. MS&P is expert in process, circuit, and system design, in MOS and bipolar technologies, and in knowledge of industry capabilities in these areas. Contact MS&P in the concept stage of your project, to maximize their ability to balance tradeoffs between the needs and difficulties of systems and of integrated circuits. Cost, performance, and schedule can all benefit from early contact with MS&P. They can act as driver of a project or as technical consultant, and are ready to perform feasibility studies on current and future concepts.

4.1.2.2 Medium/High-End Circuit Design
Manager: Mark Menezes, acting (HL1-1/R11, 225-4097)

This group performs circuit/chip LSI development for Mid-Range Systems, Large Systems, and the Interconnect groups. They have expertise in both MOS and bipolar chips. In addition to providing internal LSI chip development, they provide consulting support and evaluation of external vendor proposals. Medium/High-End Circuit Design has been the driving force behind development and characterization of state-of-the-art bipolar gate arrays at Digital. Contact them when you have questions about development of new custom LSI components, or need clarification of the trade-offs between different semiconductor technologies.

4.1.2.3 Systems and Logic
Manager: Rony Elia-Shaoul (HL1-1/S04, 225-4913)

Systems and Logic provides user support for Digital's LSI group, and performs a variety of technical functions. They make feasibility studies, generate project plans and proposals, design logic, and run the SAGE2 simulation for custom LSI designs. They primarily focus on bipolar (ECL, TTL) and NMOS technologies. Technical members of Systems and Logic are assigned to specific user groups to support their information needs. In addition, the group provides the following documents: the Custom LSI User's Handbook, the bi-monthly newsletter *MicroEclectic News*, the SEG User's Handbook (available Q4 1982), and the DEC LSI Data Book (available Q3 1982). Contact the Systems and Logic group in the preliminary product definition stage of your project. Block diagrams, performance requirements, and functionality descriptions will help them to assist you in your custom LSI needs.

4.1.3 Advanced Development
Manager: Bob Supnik (HL1-1/S08, 225-4947)

SEG/Advanced Development investigates, selects, and prototypes semiconductor-based technologies. These include semiconductor processes, design methodology, and silicon-directed architecture.

The following are Advanced Development's principal subgroups:

Process Development, managed by Ruth Rawa (HL1-1/H04, 225-4535), performs process specification development and characterization.

Design Methodology, managed by Alain Hanover (HL1-1, 225-4072), is responsible for design philosophy and tools.

VLSI Architecture (Bob Supnik, acting manager, HL1-1/S08, 225-4947) investigates VLSI architecture at the structure, component, and system levels.

VLSI Training, managed by Lee Williams (Hl1-1/S02, 225-4802), develops programs for in-house semiconductor engineering education.

University Programs, directed by Del Thorndike (HL1-1, 225-4911), is Digital's liaison to university VLSI programs.

Microware, managed by Maurice Marks (HL1-1/S06, 225-5022), is responsible for silicon-specific applications.

4.1.4 Computer-Aided Design

Manager: Joe Zeh, acting (HL1-1/R02, 225-4040)

SEG's Computer-Aided Design (CAD) group develops and supports computer-based tools used in the engineering design process. These tools are used for the physical design of LSI/VLSI chips, and for logic design at all product levels (IC, hybrid, PC, backplane, and system).

Such tools include:

- Logic Design Entry (DECDRAW)
- Logic/Fault Simulation and Microcode Development (DECSIM/TUMS/SAGE 2)
- Test Pattern Generation (DECSIM, SAGE 2)
- Circuit/Device/Process Simulation (SLIC, SPACE/SUPREM/ GEMINI)
- Automatic Layout for Gate Arrays (FINCUT/CHARIOT)
- Interactive IC Layout (CALMA)
- Design Rules, Electrical Rules, and Interconnect Verifications (DRC/ERC/IV)
- Data Base Manager (CHAS)

Four groups make up SEG CAD:

CHAS Development, headed by Carol Peters (HL1-1/O08, 225-4076), is responsible for CHAS and overall CAD architecture.

VLSI CAD Development, headed by Ed McGrath (HL1-1/Q05, 225-4086), is responsible for DECDRAW, SLIC, SPICE, SUPREM, GEMINI, new IV for VLSI, and CALMA-to-VAX hard-wired link.

LSI CAD Development, headed by Val Patel (HL1-1/Q05, 225-4842), is responsible for DECSIM, TUMS, SAGE 2, FINCUT, CHARIOT, DRC, ERC, AND IV.

CAD/Graphic Operations, headed by Bob Bureau (HL1-1/Q05, 225-4842), is responsible for providing time-sharing computers and data communications resources, CALMA and SUDS design services, and overall computer resource management.

CAD tools are no longer a luxury, but rather an absolute necessity. The tools are an integral and significant part of the engineering design process. It is important to recognize that CAD is both a great benefit and a potential limitation to the design process, especially since the technology is constantly changing. If you are an old, new, or potential user of CAD tools and have requests, concerns, or simply want to find out more, please contact appropriate people in the SEG CAD organization.

4.2 LSI TEST ENGINEERING

Manager: Prakash Bhalerad (WZ2/238-3303)

This group is broken down into Bipolar, MOS, Memories, and Computer-Aided Test Tools engineering groups. The first three groups bring new LSI devices into the corporation. They establish contacts with vendors, generate test programs, and provide overall support for LSI Manufacturing and Engineering. The fourth group, Computer-Aided Test Tool (CAT), generates test vectors for all LSI Chips and brings in test tools.

Contact the group responsible for the class of devices you are considering bringing into the company. They can supply you with information on what is available, what is qualified, and what is a problem. The groups need to know what part you plan to buy and its application.

Bipolar Engineering:	Sunil Murgai (WZ2, 238-3556)
MOS Engineering:	Ed Terrenzi (WZ2, 238-3311)
Memories Engineering:	Mike Misiaszek (WZ2, 238-3402)
CAT Tools Engineering:	Omur Tasar (WZ2, 238-3372)

5 STORAGE SYSTEMS DEVELOPMENT

Manager: Grant Saviers (ML3-6/E94, 223-9765)

Storage Systems Development is responsible for the development, strategy, and business planning for Digital's storage products. These products include semiconductor and other solid-state memory devices, arrays, subsystems, flexible disks (floppies), cartridge and cassette tape drives, 1/2-inch industry-compatible tape drives, and removable and fixed media hard disk drives of all sizes. The organization supplies these products to the corporation by both developing and purchasing them.

In addition to large product development activities in Maynard and Colorado Springs, there are Product Management, Planning, and Advanced Technology groups that support the mission of the organization. Storage products are manufactured in Colorado Springs, Colorado, in Massachusetts (Westfield, Springfield, and Natick), and in Mountain View, California. Products and subassemblies are also manufactured in Hong Kong, Taiwan, and Singapore. European requirements are partially met by facilities in Galway, Ireland.

5.1 TAPE DEVELOPMENT

Manager: David W. Brown (ML1-3/E58, 223-1923)

This group is responsible for strategy, business planning, product development, and support of tape storage products. These products are used on all systems and sold by all product lines.

Products include magnetic tape drives, formatters, and controllers, including low-cost, non-IBM-compatible devices as well as more expensive high-speed units. Examples: the TU78, TM78, TS11, and TU58. Tape Development provides its products for Digital by developing and by purchasing them.

Tape Development supports products manufactured at the Springfield, Massachusetts plant, including the TE16, TS11, TU77, and TU78. Product Support solves technical problems involving the manufacture, maintainance, and application of disk and tape products still in production or common use. They serve as the focal point for the design and implementation of Engineering Change Orders (ECOs) for tape products.

They interact with Customer Services, Manufacturing, and Systems Engineering groups during the planning, design, and testing phases of new product develoment, to ensure that total systems meet their performance and competitive requirements.

5.2 ELECTRONIC STORAGE DEVELOPMENT

Manager: Richard Morris (ML21-2/E64, 223-3094)

This group develops most of Digital's electronic storage products. They acquire and maintain applicable device technologies, along with the technical skills and product understanding needed to apply these technologies to storage systems.

Selecting the appropriate technology and systems configuration, the group designs systems, builds prototypes, and performs extensive testing before releasing the product to Manufacturing, complete with documentation and test tools.

Contact this group if your needs involve electronic storage (for example, bipolar/MOS devices or bubbles). To best satisfy your needs, the organization needs to know schedule and budget constraints, reliability and performance goals, and be allowed to participate in the conceptual phase in assessing various alternatives.

The group is organized as two distinct departments, Electronic Storage Technology (described in Section 5.2.1 of this chapter), and Electronic Storage Systems Development, organized as follows:

Small Systems Applications (supervisor: Bill Coates, ML21-2/E64, 223-3410), focuses on Q-bus development and the application of electronic storage technology to terminals.

Medium Systems Applications (supervisor: Tony Zacconi, ML21-2/E64, 223-5318) focuses on Unibus developments and the small/medium VAX systems (Tewksbury support).

Large Systems Applications (manager: Dave Ellis, ML21-2/E64, 223-3028) focuses on DECsystem-10 and DECSYSTEM 20 applications, Venus, and various special complex storage issues.

5.2.1 Electronic Storage Technology

Supervisor: Dave Dutton (ML21-2/E32, 223-6020)

This department selects, characterizes, and qualifies electronic devices and technologies that have significant potential for product application.

The group works with the electronic device vendor community. They do extensive analytical and empirical evaluation of devices to reveal failure modes, operating margins, functional issues and technology trends, as well as developing suitable test tools and specifications.

They have substantial expertise in device analysis and testing, reliability issues pertaining to semiconductors and magnetic bubbles, and the selection of test equipment and life test facilities.

Contact Electronic Storage Technology if you need data on current and future electronic storage devices, or help in selecting the appropriate device for your application.

5.3 STORAGE ADVANCED DEVELOPMENT

Manager: Mike Riggle (ML1-3/E58, 223-5316)

The Storage Advanced Development group is responsible for acquiring a technology base sufficient to allow Digital's storage products to be competitive. The group's efforts are a mix of technology acquisition and development. Advanced Development generally develops or trades critical, fast-moving technology, since it is hard to acquire it otherwise.

The group works with digital and analog circuits, magnetic recording, servos, memory subsystems, large scale integration, mechanical systems, recording and error correcting codes, component development, solid state memories, and optical memories.

They provide technology and, sometimes, product breadboards to product development groups. Consultation on a variety of storage issues is also available.

Storage Advanced Development includes four subgroups:

- Heads and Components Development, Maynard
- Storage Systems and Memories Advanced Development, Maynard
- Media Development, Colorado
- Advanced Disk Technology, Colorado

5.4 NEW ENGLAND STORAGE SITE TECHNICAL OPERATIONS

Manager: James Lacey (ML3-6/E42, 223-3730)

This group provides a variety of support services for the Storage Systems Development organization. They participate in all phases of product development by designing diagnostic and test strategies, providing design and documentation support, computer services, and capital equipment management. These and other services are discussed in the following sections.

5.4.1 Storage Systems Diagnostics-Maynard

Manager: Dan Deknis (ML21-4/E10, 223-4163)

This group designs and develops diagnostics for Digital's disk, memory, and tape products. They provide products and services to Engineering, Manufacturing, and Field Service. They also play a key role in the selection of vendor hardware. The group provides consultation and assistance in the early stages of product development to improve product diagnosis.

Storage Systems Diagnostics develops software for Engineering to verify that hardware is in compliance with hardware specifications. They provide software to aid in breadboard and prototype debugging. Additionally, the group provides software to evaluate vendor hardware and to aid in Design Maturity Testing (DMT).

The group develops software for use in Manufacturing during Process Maturity Testing (PMT), unit production, and Final Assembly and Test (FA&T). Module test programs for standard testers are also developed here.

Finally, the group provides software to Field Service to verify complete system installation, to effect a high degree of fault detection and isolation (to speed up the Mean-Time-to-Repair), and to complement other tools in providing preventive maintenance services.

5.4.2 Design Services-Maynard
Manager: Richard Cook (ML3-6/E42, 223-2984)

This Engineering Services group provides hardware-oriented services to New England Storage Systems as described in Chapter 6, Section 1.4.3 on Engineering Services.

5.4.3 Engineering Systems and Tools-Maynard
Manager: Bob Barnes (ML3-6/E42, 223-3854)

This group manages the operation of New England Storage Systems computer services and facilities. Multi-user and timesharing services are provided on PDP-11/70, VAX, and DECSYSTEM 20 systems, with emphasis in site software support (DEC20-RSX-11M+) and operator services. Facilities planning, consulting, and implementation are additional services. Computer-aided design (CAD) timesharing support is planned for Q2 FY82.

Engineering Systems and Tools provides functional management of capital planning for all computers, systems, add-ons, and software, including hardware test equipment. They coordinate Storage Systems Development's office automation, networking, and communications efforts with Digital's overall efforts.

5.4.4 Technical Administration Support-Maynard
Administrator: Susan Goff (ML3-6/E42, 223-3285)

This group provides technical administration support to Storage Systems Development.

Technical Administration Support can supply you with information about audio/video (slow scan) teleconferencing, and space management policies and procedures within Storage Systems Development.

They also maintain Engineering Stockroom 132. Contact them for acquisition assistance and for information about components used in Storage Systems devices.

5.5 COLORADO STORAGE SYSTEMS ENGINEERING
Manager: Demetrios Lignos (CX, 522-2100)

This group is responsible for strategy, business planning, and development of medium and large disk drives and attachments (controllers) for storage products. Selecting the appropriate technologies, the group designs, builds prototypes for, and tests entire disk subsystems. Products are released to Manufacturing complete with documentation and test tools.

Contact this group if you need information on mid-range and large disks and controllers for storage devices. They are knowledgeable in disk recording, servo-current technologies, and LSI and VLSI technology. They work to define disk subsystem architectures and interface protocols. They also monitor and understand the competition, and develop the strategy and make business recommendations for medium and large disk and disk subsystems development.

The group is organized as follows:

5.5.1 Fixed Disk Products
Manager: Paul Esling (CX, 522-2228)

This group is responsible for the development of Winchester-type products, such as the RM80 and later drive families. Head-to-disk assemblies (HDAs) containing data are not removable on these products.

5.5.2 Removable Disk Products
Manager: Bill Glover (CX, 522-2222)

This group develops and supports all removable cartridge and disk pack drive products. In addition, they support all removable products purchased from outside vendors (for example, RMs and RPs).

5.5.3 Subsystems Engineering
Manager: Phil Arnold (CX, 522-2229)

This group develops attachments (intelligent controllers) for disk and tape storage devices. The following functions are included:

- Controller hardware and software development activities
- LSI/VLSI development group
- Colorado diagnostics
- Subsystems packaging group (cabinets, configurations, FCC compliance)

5.5.4 Colorado Operations
Manager: Wes Brown (CX, 522-2001)

This group provides engineering design support for Colorado (drafting, layout, documentation). They are also responsible for Colorado engineering facilities management, the Library, Model Shop, and CAD/CAM tools and systems.

5.5.5 Site Management
Manager: Demetrios Lignos (CX, 522-2100)

Site Management for Colorado Storage Systems Engineering is administratively responsible for interfacing with and assisting various engineering support groups located in Colorado. The support groups include Customer Services, Component Engineering and Technical Publications.

5.6 SMALL DISK PRODUCT DEVELOPMENT
Manager: Paul Bauer (ML1-3/E58, 223-6581)

This group is responsible for strategy, development, release to manufacturing, and support of small disks, both floppy and hard. These storage subsystems include:

- Floppy disk devices, controllers, and systems interfaces (RX01, RX02, and RX50)

- Small removable and fixed head disk devices, controllers, and system interfaces (RD50, RD52, AZTEC)

Small Disk Product Development works with most of Digital's engineering and product line groups.

5.7 STORAGE SYSTEMS PRODUCT MANAGEMENT

Manager: Mike Gutman (ML3-6/E94, 223-5285)

This group is responsible for managing all products developed in Storage Systems Development. The group facilitates communication between technology and marketing, enabling Storage Systems Development to view the marketplace and Marketing to assess the current technology. The organization is involved with a product from cradle to grave, from conception and development through first-customer-ship and product phase-out.

The group integrates the marketing and development plans of several organizations, develops long-term product strategy, generates and obtains approval of business plans consistent with long-term strategy, and coordinates activities necessary for the successful introduction of sales and service of Storage Systems Development products. It also reviews and analyzes products against corporate profit and market objectives, and continually conducts analyses of Digital's competition.

Products	*Product Managers*	*Mail Stops/DTNs*
RM02/03/80	Paul Ferester	ML3-6/E94, 223-4962
RP06/07, RM05	John Forde	ML3-6/E94, 223-3516
RL01/02	Dan Dillon	ML3-6/E94, 223-7871
Floppy Disks	Dick Leslie	ML3-6/E94, 223-6964
RK05/06/07	John Woelbern	ML3-6/E94, 223-5015
Cartridge Tape TU58	Dick Leslie	ML3-6/E94, 223-6964
Memory	Pete Durant Celeste LaRock	ML3-6/E94, 223-2147 ML3-6/E94, 223-8897
1/2" Tape	Sergio Kogan	ML3-6/E94, 223-8260
HSC, UDA	Tom Rarich	ML3-6/E94, 223-6809
AZTEC	Larry Tashbook	ML3-6/E94, 223-5297
R81, RA60	Kevin Smith	ML3-6/E94, 223-5880

6 DISTRIBUTED SYSTEMS

Manager: Bernie Lacroute (TW/A08, 247-2113)

This organization is responsible for the architecture, development, and implementation for the following distributed system products: network products for DEC-to-DEC communication (DECnet), Digital-to-IBM communication (Internet), the connection of Digital equipment to Public Packet Networks such as X.25 (Packenet), hardware communication products for 16-, 32-, and 36-bit computers, and the development of local area network structures and communication subsystems.

6.1 DEC INTERCONNECT

Manager: John Gilbert (TW/E07, 247-2673)

This group is responsible for the development of any DECnet product implementing Distributed Network Architecture (DNA). The group develops funding and product implementation strategies. These strategies are aligned with the overall long-term strategy for all software DECnet products.

The group is basically engaged in product development, product support and maintenance, program support, and advanced development.

Contact the group if you have questions concerning DECnet performance criteria and performance measurements. The group develops DECnet-11M/S, DECnet-11M+, and DECnet-RT products, and is responsible for DECnet 10/20, DECnet-E(RSTS/E), and DECnet-VMS strategy.

6.2 DISTRIBUTED SYSTEMS HARDWARE DEVELOPMENT

Manager: Bob Savell (TW/E05, 247-2604)

Distributed Systems Hardware Development consists of three subgroups:

6.2.1 Network Engineering

Manager: Tom Ermolovich (TW/C04, 247-2388)

Network Engineering develops all systems communications products for Ethernet networks. These include network adapters to interface Digital's computers to the Ethernet cable, transceivers, wire selection, and repeaters, and production of the Ethernet specification in collaboration with Xerox and Intel. Network Engineering also ensures that systems of computers interconnected by these devices operate properly.

6.2.2 Communications Subsystem Engineering

Manager: Jim O'Loughlin (TW/E07, 247-2110)

Communications Subsystem Engineering develops communications products that connect to the Ethernet. Their major current development project is PLUTO, an 11/24-based communications system. PLUTO will perform routing and gateway functions for the Ethernet, allowing different networks to communicate, and will also enable terminals to switch among many systems connected to the Ethernet.

6.2.3 Communications Engineering

Manager: Dick Brewer (MK1-1/M37, 264-5825)

Communications Engineering develops non-Ethernet communications products, which generally fall into the lower-speed RS232 category. These include modem products, used to interface Digital products to telephone communications lines. Other products are processor bus options, used to interface Digital computers to terminals and other computers at speeds of up to 1 MHz, both point-to-point and multidrop.

6.3 DISTRIBUTED SYSTEMS ARCHITECTURE
Manager: Tony Lauck (TW/C11, 247-2137)

This group provides a technical focus for the Distributed Systems program, defines the overall Digital Network Architecture (DNA), and defines and maintains the specifications of key interfaces and protocols that make up the architecture.

In addition to developing and maintaining specifications, Distributed Systems Architecture provides consulting services and operates the DECnet Review Group (DRG), a forum for product implementors to review and approve architectural specifications.

If you are developing a hardware or software product that will be a component of a distributed system, contact this group to receive assistance in understanding or interpreting a DNA interface or protocol. The group can also help you resolve incompatibilities among products that are supposed to adhere to the architecture. The group can also modify the architecture to satisfy the needs of new product development.

6.4 LOCAL AREA NETWORK SERVERS-IBM AND X.25 PRODUCTS
Manager: Dave Rodgers (TW/C04, 247-2369)

This group develops strategies for IBM and X.25 communication products, and the software for local area network communication services, such as terminal concentrators and gateways.

6.5 PRODUCT ASSURANCE
Manager: Doug MacKenzie (TW/C11, 247-2381)

This group ensures that Distributed Systems' network products are compatible with each other, and have known levels of performance against which customer requirements can be matched. They also develop the software tools used to design and properly configure networks.

6.6 CROSS-PRODUCT ENGINEERING
Manager: Kami Ajgaonkar (TW, 247-2249)

This group maintains released products and manages the Distributed System group computer resources.

7 32-BIT SYSTEMS PROGRAM
Manager: Bill Demmer (TW/D19, 247-2111)

The 32-Bit Systems Program has 3 major functions:

- Program Management for all 32-Bit Systems activities.
- Line Management for Small and Mid-Range 32-Bit Systems.
- Line Management for the Shared and Advanced Development functions supporting these programs.

7.1 TEWKSBURY SITE MANAGEMENT AND SHARED RESOURCES

Manager: Jim Marshall (TW/A03, 247-2201)

This organization is made up of these functional groups: Advanced Systems Development, System Certification, Shared Resources, and the Configuration Program.

7.1.1 Advanced Systems Development

Manager: Jim Marshall, acting (TW/A03, 247-2201)

This group is responsible for all 32-bit mid-range advanced development. They are currently involved in base technology requirements, architecture studies, system studies including hardware breadboard evaluation, and design process evaluation and developments such as CAD tools.

7.1.2 System Certification

Manager: Mike Powell (TW/C02, 247-2856)

This group provides test planning and management services for the 32-bit program. Their primary responsibility is to plan, coordinate, and drive the testing of products prior to release. Test issues include architectural verification, functional operation, environmental specifications, electromagnetic interference, safety, performance, reliability, and others. Adherence to Digital Standards, international regulatory standards, and various other specifications is also included.

VAX System Certification administers the VAX New Products Committee (VNPC). The VNPC consists of representatives from Engineering, Manufacturing, Customer Services, and other groups concerned with the supportability of new products on VAX systems. Acting as an agent of the VAX system product managers, the VNPC provides them with detailed information about Digital's readiness to support announcement and shipment of new products.

7.1.2.1 Base System Diagnostic Engineering

Manager: Don Wunschel (TW/F17, 247-2210)

This group provides diagnostic engineering for VAX-based system products and Distributed Systems hardware products.

They work closely with Engineering, Manufacturing, and Field Service to establish product test requirements, define diagnostic strategies, perform product testability analysis, and implement methods and diagnostic tools.

The group provides diagnostic end users with breadboard and prototype debug tools, hardware design verification tools, manufacturing test software tools, and Field Service installation and corrective maintenance software tools.

The group administers and implements Engineering Change Orders (ECOs) to VAX-based system diagnostic products.

Base System Diagnostic Engineering also releases all VAX diagnostic software.

7.1.3 Shared Resources
Manager: Fred Lund (TW/D17, 247-2694)

This group consists of four different design support organizations: Power and Packaging Development, Design Services, Computer Resources, and Material Control. Each of these groups provides a support service to the Tewksbury product development function.

7.1.3.1 Power and Packaging Development
Manager: Nelson Velez (TW/C17, 247-2435)

This group designs and documents power supply systems and product packaging for products under development in Tewksbury.

7.1.3.2 Design Services
Manager: John Carter (TW/D17, 247-2560)

This group provides all of the design support services required by the Tewksbury Development Functions. These include drafting, printed circuit layout, gate array layout, Engineering Change Orders (ECOs), reproduction, and documentation control. See Chapter 6, Section 1.4.3, for more information on Engineering Services.

7.1.3.3 Computer Resources
Manager: Tony Baublis (TW/C14, 247-2453)

This group provides the computer resources required by the Tewksbury Development and tenant operations. This includes support of the CAD5 and CAD6 systems and of other general purpose timesharing systems.

7.1.3.4 Material Control
Manager: Bill McMahon (TW/D17, 247-2869)

This function provides stockroom, shipping and receiving, and prototype kitting services for the Tewksbury Development group.

7.1.4 Configuration Program
Manager: Arnold Kraft (TW/A03, 247-2974)

This group is developing software tools and supporting knowledge acquisition procedures to assist in configuring customer's quotes and orders. The tools will be employed by all major functional groups at Digital, including Manufacturing, Sales, Customer Services, Order Administration, and Engineering.

7.2 ADVANCED VAX SYSTEMS
Manager: Demetrios Lignos (TW/C04, 247-2416)

This organization develops future VAX systems, technologies, and tools, to be utilized across the VAX family of products. Contact these groups on any issue concerning future VAX products.

7.2.1 Low Mid-Range VAX Development
Manager: Demetrios Lignos, acting (TW/C04, 247-2416)

This group defines system products in the lower mid-range VAX price band. They use advanced technology studies to design and develop new CPUs incorporating custom VLSI into the product design. Included is the specification of these systems with communications and mass storage products developed in other groups.

7.2.2 Technology
Manager: Geoff Potter (TW/B02, 247-2181)

This group develops new technologies for the mid-range VAX systems. The group focuses on semiconductors, CAD tools, power and packaging, cooling, printed wiring board interconnect and connector requirements, and microprogramming tools.

7.3 MID-RANGE VAX SYSTEMS
Manager: Brian Croxon (TW/C04, 247-2416)

This organization is responsible for the complete product development of the VAX family of systems. They implement the Central Engineering VAX product strategy, from initial product development to the release of the product to Manufacturing.

VAX Systems is made up of these systems management groups:

7.3.1 Systems Management-VAX 11/780
Manager: John Holz (TW/C04, 247-2265)

This group has the overall systems responsibility for strategy and activities for VAX 11/780-based products. This includes Marketing and Product Management, Engineering, System Test, and System Support as well as Customer Services and Manufacturing.

Contact this group on any issue concerning products that may interface with or attach to the VAX 11/780 system.

7.3.2 Systems Management-VAX 11/750
Manager: Charlie Smith (TW/D06, 247-2304)

This group provides system management for the VAX 11/750. They are responsible for the development and enhancement of the VAX 11/750 product.

Contact this group if you are working on a product that might be interfaced or attached to the 11/750 system. They can provide knowledge and expertise on how a product should be designed to ensure production of a reliable, integrated system.

7.3.3 Systems Management-NEBULA

Manager: Mary Breslin (TW/E07, 247-2600)

This group has overall systems development and product coordination responsibility for the NEBULA project. NEBULA is a new, low-cost implementation of the VAX architecture; aimed at the low-end 32-bit marketplace. Contact them if you are developing products which might interface or attach to the NEBULA system.

7.3.4 High Mid-Range VAX Development

Manager: Don McInnis (TW/C04, 247-2118)

This group defines system products in the upper mid-range VAX price band. Advanced technology studies are used to design and develop new CPUs. Included is the specification of these systems with communications and mass storage products developed in other groups.

7.4 32-BIT SYSTEMS PROGRAM OFFICE

Manager: John O'Keefe (TW/A08, 247-2724)

The 32-Bit Program Office creates and publishes the product strategy for all 32-bit systems. In conjunction with engineering, system, and product managers, the 32-Bit Program Office recommends a new product investment plan that can be supported by the Product Lines, Manufacturing, Field Service, and other functions. In addition, they develop the marketing implementation plan for all 32-bit systems. The overall goal of the Program Office is to produce, document, and communicate a superior long-range plan for 32-bit systems.

7.4.1 32-Bit Systems Product Planning

Manager: Steve Rothman (TW/A08, 247-2013)

This group defines the 5- to 10-year product strategy for 32-bit systems. They define priorities and make recommendations for allocation of funds for submission to the Operations Committee.

7.4.2 32-Bit Systems Business Planning

Manager: Ken Nisbet (TW/A08, 247-2470)

This group plans strategic investment in the 32-bit product area.

Product Planning generates a "menu" of products that 32-Bit Systems Business Planning treats as potential business investments. They work closely with 32-Bit System Product Management and Business Analysis to develop and monitor quality business plans. They also create a Systems Pricing Model for 32-Bit Systems.

7.4.3 32-Bit Systems Product Marketing

Manager: Dave Chanoux (TW/A08, 247-2580)

This group develops and implements strategic marketing plans for 32-bit products. They work with System Product Managers and Component Product Managers on new product introduction strategies, including advertising, sales promotion, communication with the field, and sales training. This group is responsible for insuring that strategies are consistent across the 32-bit product space.

8 LARGE SYSTEMS PRODUCT DEVELOPMENT
Manager: Ulf Fagerquist (MR1-2/E78, 231-6408)

The primary goal of the Large Systems Product Development organization is to develop and implement the high-end portion of the corporate product strategy for VAX architecture-based systems and all DECSYSTEM 10/20 products.

8.1 LARGE VAX SYSTEMS TECHNOLOGY AND ADVANCED DEVELOPMENT
Manager: George Hoff (MR1-2/E78, 231-6524)

This group is responsible for 32-bit System Programs.

8.1.1 Large VAX Engineering
Manager: Alan Kotok (MR1-2/E47, 231-7381)

This project group is currently developing VAX-11 processor units to be marketed in the $150-300,000 price range. Group engineers have experience in these technical disciplines: VAX architecture, high performance CPU design, floating point processor design, console design, cache/memory subsystem design, and microprogramming.

The group makes extensive use of SUDS (Stanford University Design System), IDEA (Interactive Design and Engineering Analysis), SAGE (Simulation of Asychronous Gate Elements), microcode simulation, and systems performance evaluation tools. The group is involved in the application of sub-nanosecond technology and high-density components (LSI) to achieve high-performance processor structures.

Contact the group if you wish to investigate advanced implementations of the VAX-11 architecture, the application of high-performance technology to CPU structures, and advanced approaches in applying RAMP (Reliability and Maintainability Program) techniques to improve system availability. Although the group is focused on a specific project and not available to assume additional development tasks, they will provide consultation and assistance to any group requiring their expertise.

8.2 TECHNOLOGY AND ADVANCED DEVELOPMENT
Manager: Sultan Zia (MR1-2/E47, 231-6277)

This group provides engineering resources to assist in technology development for Large Systems products, both in the VAX-11 series and the DECSYSTEM 10/20 series. The group includes engineers experienced in these areas: ECL (Emitter Coupled Logic) technology (10k and 100k), high-density gate arrays, complex multi-layer modules, circuit simulation (propagation delay and noise margin), LSI packaging and cooling, system level packaging, clock design and distribution, UL/CSA/VDE compliance requirements for large systems and power distribution.

Contact the group for information about high-performance technology. The group has extensive experience in the development of KL10- and KS10-based systems. As a functional group, they are chartered to provide support to development groups throughout Digital, resources permitting.

8.3 DECSYSTEM 10/20 DEVELOPMENT
Manager: Bill McBride (MR1-2/E85, 231-6906)

This group is responsible for all 36-bit system programs, current products, and Large System peripheral integration.

8.3.1 New 36-Bit Hardware Development
Manager: Len Kreidermacher (MR1-2/E85, 231-6617)

New 36-Bit Hardware Development for DECsystem-10 and DECSYSTEM 20 is concerned with all the engineering aspects of DECsystem-10 and DECSYSTEM 20 development. These include logic design and implementation, mechanical implementation, packaging, and power supply.

The group's goal is to satisfy the product requirements of performance, cost, and time-to-market. To meet this goal, they use available technologies and aids, and when required, sponsor the development of new methods and techniques (for example, multiwire, CAD tools, simulations).

Contact the group if you need to make a physical interconnection to a DECsystem-10 and DECSYSTEM 20 under development, or if interested in performance specification issues relating to the group's products.

8.4 LARGE SYSTEMS GROUP ADVANCED DEVELOPMENT
Manager: Ron Melanson (MR1-2/E85, 231-6419)

This group is developing Large Systems Group's future CAD system for the development of new products. This system, called CHROMA, is an interactive schematic and physical editor that supports hierarchy, connection verification between schematic and physical layouts, design rule checking, and simulation. CHROMA is currently being used experimentally in the design of LSI bipolar intergrated circuits. It is scheduled for release to LSG engineers in December of 1982.

8.5 MARLBORO SITE ENGINEERING
Manager: Dave Copeland (MR1-2/E78, 231-4012)

Marlboro Site Engineering provides design layout and documentation services, computer services, CAD tools, and engineering processes for Large Systems and other Marlboro groups.

8.5.1 Computer Systems Technical Support
Manager: Bob Hickcox (MR1-2/E69, 231-6227)

Computer Systems Technical Support provides a wide range of computer and network support services to the Large Systems group.

8.5.2 Marlboro Engineering Services
Manager: Nick Cappello (MR1-2/E18, 231-6261)

Marlboro Engineering Services provides design layout and documentation services to Large Systems Group Engineering and other Marlboro development engineering groups. Services provided include:

- Mechanical drafting and documentation
- Printed circuit board layout
- Logic design drafting and documentation
- Document and reproduction control

They also provide process planning and support to Large Systems Engineering projects. See Chapter 6, Section 1.4.3 for more information on Engineering Services.

8.5.3 Large Systems CAD
Manager: Vehbi Tasar (MR1-2/E18, 231-5565)

This group is responsible for developing Computer-Aided Design (CAD) tools needed for Large Systems hardware engineering. Their areas of involvement include logic schematics systems, gate and register-transfer level simulation tools, automatic design verification programs, and placement and routing tools.

8.6 LOGICAL DESIGN CAD SYSTEMS
Manager: Roy Rezac (MR1-2/E18, 231-4140)

This group is responsible for Corporate tools for Logical Design CAD, as well as overall CAD system architecture. These are tools such as Schematics, SUDS, Simulation, and Microcode. This group has program management responsibility, while some aspects of development and support work are contracted out to other organizations within Digital. They also do work and planning in the areas of Design Methodology and Engineering Process.

8.7 OPERATIONS
Manager: Steve Sur (MR1-2/E78, 231-6462)

Digital develops individual products which must be integrated into plans. The Operations Group provides system integration and linkage of Large Systems plans, and assesses progress made towards these stated goals.

The group works to ensure that development groups use the tools available to them during the product development process. Examples of these tools are the Product Business Plan Standard (DEC STD 130) and the Phase Review Process Standard (DEC STD 028). They coordinate the interpretation of these tools within Large Systems, to ensure that development efforts are monitored on all major programs, predictability levels are achieved and measured, and that plans are fully integrated across Large Systems.

9 TERMINALS
Manager: Bill Picott (ML1-2/H26, 223-8076)

This group designs and develops high-volume video and hard copy terminal products. They focus on advanced development, product development, product support, product design services, and planning terminals strategy. The group's products require some of the highest volume electromechanical and plastics tooling in Digital. They furnish many product services to other engineering groups, through their mechanical engineering and product design group, printed circuit design group, power supply engineering group, and 16-bit diagnostics group. Terminals regularly supplies a customer-level product design to Manufacturing. They also design basic terminal components to which other groups add some function or specific application.

Contact the group for solutions to problems associated with designing, manufacturing, or using high-volume terminal products.

9.1 TERMINALS TECHNICAL DIRECTOR
Manager: Walt Tetschner (ML5-3/E12, 223-6788)

This group provides technical leadership and management for common terminal components and architectures. Problems or requirements for keyboards, terminal communication features, or standards associated with high-volume terminal products are handled by this group.

9.2 HARD COPY TERMINALS

Manager: John Ring (ML1-3/E62, 223-6840)

This group designs impact dot-matrix printer terminals, including keyboards, printheads, mechanisms, and packaging, and is responsible for high-volume buyout line printers.

Contact Hard Copy Terminals when you want advice about selecting specialized products, or if you need help in modifying a terminal. Group members can also evaluate vendor terminals (for example, printers and card readers) that you may be planning to acquire.

Other groups within Hard Copy Terminals Engineering include:

Group	*Manager*
Line printer products/ Advanced Development	Tom Dundon (ML5-3/E12, 223-8305)
Matrix printer products/ Advanced Development	Frank Digilio (ML1-3/E62, 223-33778)
LA200 printer products	Paul Nelson (ML5-3/E12, 223-3528)
Support (Phoenix)	Dave Gretton (PN, 602-869-5273)

Printer Engineering Advanced Development does research in support of printer product development. Some examples of the concepts explored by this team include new keyboard technology, alternate printing technologies (thermal, electrosensitive, and electrophotographic), and extensions of impact matrix printing. Advanced Development is also performed within Frank Digilio's printhead group.

9.3 VIDEO DEVELOPMENT

Manager: Don Haney (ML1-2/H26, 223-9243)

This group designs and develops video products that can either serve as entry-level devices or be upgraded to more sophisticated systems. The group concentrates on three areas: video display terminals, advanced terminals, and graphics. Contact the team leaders or the group manager when you are building or modifying a video terminal, or when you need general information on video or graphic architectural techniques.

The *Base Video* team, headed by Jerry Bourque (ML1-2/H26, 223-3295), is responsible for the design and development of interactive video display terminals.

The *Advanced Terminals* team, headed by Don Haney (ML1-2/H26, 223-9243), is responsible for developing new techniques, architectures, and applications of technology for future video terminal products.

The *Graphics Terminals* team, headed by John Elsbree (ML1-2/H26, 231-6939), is responsible for video-based graphics devices that include graphic terminals, graphic architecture, and ancillary devices.

The *Video Support* group, headed by Jerry Bourque (ML1-2/H26, 223-3295), supports the VK100 and corporate terminals, including the VT100, VT100 derivatives, and PDT11-110/130. They help Manufacturing, Marketing, and Customer Services resolve production and customer problems, improve quality and yields, and reduce costs.

9.4 PRODUCT ASSURANCE

Manager: Joe DeMarinis (ML1-2/H26, 223-5687)

This group supports development projects and some terminals in production. They provide technical assistance, engineering change order (ECO) coordination, engineering documentation, design services, and engineering pre-release product testing.

Product Assurance, headed by Joe Bitto (ML1-2/H26, 223-5521), provides technical assistance and product testing for all Terminals Engineering product development projects, to verify function, reliability, and compliance with product specifications, Digital standards, and external regulatory requirements.

Power Supply Engineering, headed by Art Parker (ML8-4/E86, 223-2146), designs and tests power supplies for Terminals Engineering, Computing Terminals, and Small Systems Engineering.

9.5 FIRMWARE DEVELOPMENT

Manager: John Wagner (ML1-2/H26, 223-7274)

This group designs, implements, documents and validates the firmware used in the products developed by Terminals Engineering. They specialize in firmware application and development skills, particularly in the areas of video devices, keyboards, and hard copy terminals.

They are also responsible for 16-bit diagnostic assistance, special tools, diagnostic release, PDP/LSI-11 tools, and DECX maintenance.

9.6 MECHANICAL DESIGN/DESIGN SERVICES

Manager: Dick Gonzales (ML6B-2/E66, 223-4832)

This group provides mechanical engineering support in the development of 16-bit and terminal products. They also provide printed circuit design services for these products and offer their services for non-standard product development throughout Digital.

Group members stay abreast of new design techniques that may facilitate new product development. They engage in advanced development of electromechanical devices, packaging techniques, and plastics technology and application.

10 COMPUTING TERMINAL (CT) PROGRAM
Manager: Avram Miller (ML5-2/T53, 223-9441)

The Computing Terminal (CT) Program is responsible for managing all aspects of the planning, development, manufacturing, and service of Digital's tabletop computer products. The managers responsible for the various elements of the program are listed below.

Hardware Development	Art Williams (ML5-2/T53, 223-3954)
Software Development	Ron Ham (ML12-3/A62, 223-3740)
Manufacturing	Vah Erdekian (ML5-2/T53, 223-1393)
Product Management	Ed Lazar (ML4-3/T64, 223-8927)
Customer Services	Darrel Bates (ML5-2/T53, 223-2763)
Product Assurance	Al Shimer (ML5-2/T53, 223-1394)
Operations and Control	Bob Sanfacon (ML4-3/T64, 223-8662)

11 EUROPEAN ENGINEERING
Manager: Jim Wade (Geneva, Switzerland: GE, E3102, [41]-(22)-933311)

European Engineering consists of the Central Engineering activities that take place in the European area. The group is responsible for product development and planning.

11.1 PRODUCT DEVELOPMENT

Basing Central Engineering product development activities in Europe helps Digital to design and implement products specific to European area needs, to draw on a pool of engineering talent that is not otherwise available to us, and to demonstrate a full local "presence". That capability is sustained by allocating mainstream corporate (worldwide) projects to European Engineering's Product Development groups.

11.1.1 European Software Engineering
Manager: Dick Davies(Reading, UK: RY, [44]-(734)-868711)

European Software Engineering (ESE) develops a variety of software products. They focus on commercial applications and distributed systems. In addition to software engineers, the group has full support services from technical writers, quality engineers, and a hardware administration group.

Contact ESE when you need information about products they are developing or planning.

11.1.2 European Distributed Systems Hardware Engineering
Manager: Bob Suarez (Reading, UK: RY, [44]-(734)-868711)

European Distributed Systems Hardware Engineering extends the Distributed Systems software capability in Reading to provide a total comms/nets product development center. Initial products include terminal modem options and a Q-bus 8-line multiplexer.

11.2 PRODUCT PLANNING

Product Planning is concerned with planning future products that take into account specific European requirements. The group is involved in any product area that demands special European considerations, regardless of where the product is developed. Emphasis is placed on their need to be involved early in product development cycles. Engineers should bear this in mind when contacting the appropriate Product Planning group. Product Planning includes the following organizations:

11.2.1 Safety/Environmental Regulations

Manager: Jan Scherpenhuizen (Geneva, Switzerland: GE, D3304, [41]-(22)-933311)

European area products are affected by a variety of special technical requirements. Some are legislative; some are driven, for example, by trade union pressures. The Safety/Environmental Regulations group ensures that these requirements are clearly documented and available as early as possible to engineers and product managers. Wherever possible, they make information available through established engineering channels, like Standards and Hardware Design Assurance (see Chapter 6 on Engineering Support Groups).

This group is also responsible for European implementation of the Corporate Product Safety program, involving coordination of all field, manufacturing, and engineering activities.

11.2.2 Telecommunications Regulations

Manager: Robert Boers (Geneva, Switzerland:GE, E3310, [41]-(22)-933311)

Like Safety/Environmental Regulations, the Telecommunications Regulations group ensures that clear and up-to-date information on European technical requirements is available to engineers and product managers. They specialize in the requirements imposed by the telecommunications facilities and organizations in Europe.

11.2.3 Commercial Product Planning

Manager: Ron Schuler (Geneva, Switzerland: GE, E3312, [41]-(22)-933311)

Commercial Product Planning ensures that the market needs of the European area are part of the long-range product planning activities of the Commercial Engineering Group. Working closely with the European representatives of the Commercial Product Lines, the group prepares market and product requirements statements, including appropriate business impact figures.

11.2.4 Distributed Systems Product Planning

Manager: Franco Malerba (Geneva, Switzerland:GE, E3104, [41]-(22)-933311)

Like Commercial Product Planning, this group ensures that corporate strategies take European market needs into account. Distributed Systems Product Planning specializes in the application of Digital's future communications and networks products to Europe.

11.3 US COORDINATION

Manager: Bryan Fifield (ML11-3/H19, 223-9620)

European Engineering maintains a permanent representative in the Mill. US Coordination plays a key role, enabling engineers and product managers to interact on a day-to-day basis on international product matters.

CHAPTER 6

ENGINEERING SUPPORT GROUPS

1 TECHNICAL OPERATIONS
Manager: John Holman (ML12-2/T36, 223-5533)

1.1 PRODUCT DESIGN ASSURANCE
Manager: Bruce Smith (ML3-4/E67, 223-6740)

1.1.1 Systems Evaluation Engineering
Manager: John Larkin (ML3-4/E67, 223-5230)

Systems Evaluation Engineering (SEE) provides specialized testing, tools, and consultation services for Digital's product lines, engineering and manufacturing groups, and Field Service organizations. SEE's testing relates to the operation of computer systems, their components and interaction. Hardware and software tools enable the performance of tests that provide the metrics for systems analysis. SEE's consultation services provide system-level expertise and facilities for system test and validation throughout all phases of product life.

Systems Evaluation Engineering's test plans, tools, and reports provide verification and validation information for various approval bodies within Digital. This data is used for risk assessment analysis for the overall improvement of our products.

Systems Evaluation Engineering has all the computer laboratory facilities, tools, and staff needed to provide you with test plans, tools, test configurations, and reports. Contact them early in the development cycle, to ensure that plans and personnel will be available. For a complete information package, contact SEE at 223-2139.

1.1.2 System Parameter Testing
Manager: Bruce Smith (ML3-4/E67, 223-6740)

This specialized team of test engineers works on improving the Engineering release testing process to reduce integration problems and new product start-up costs in System Manfacturing. Team members develop models to analyze, evaluate and resolve test process problems. They support selected product-specific efforts that serve as "test beds" for process improvements. In addition, they modify existing and proposed specifications and standards to more accurately reflect test requirements. The team also provides testing consultation for Engineering and Manufacturing groups.

1.1.3 Hardware Design Assurance

Manager: Dick Amann (ML11-3/H19, 223-9837)

This group's primary function is to ensure that there exists within Digital the necessary tools, standards, and organizational processes to enable Digital's products to fit into the marketplace relative to hardware-oriented regulations, standards, and compatibility.

The group's strategy includes driving functions which are necessary for adequate Hardware Design Assurance. These functions are organized either within or external to the group, or depending on the most sensible strategy. The group presently has the nucleus of EMI, International Regulations, and hardware standards. These activities will gradually be decentralized to groups in which they can be more effective.

Most of the group's activities are provided on a a pay-as-you-go basis. Some of the services previously provided at no cost will be charged for where appropriate. Central funding will be limited to corporate cross-product activities, and seed money to start new activities. All central funding is spent in the group's cost center with the exception of Product Safety funding. This funding is allocated to the Corporate Product Safety group for safety service to Central Engineering.

The group provides consultation on design problems in the EMC area. They integrate Engineering, Marketing, Manufacturing, and Field Service efforts relative to EMC, and determine what quality assurance programs are needed in manufacturing to guarantee consistent EMC characteristics in Digital's products. EMC testing services are also provided. They place special emphasis on identifying the radiated emission characteristics of Digital's products and ensuring compliance to FCC and VDE regulations.

1.1.3.1 International Regulations

Manager: Dick Amann (ML11-3/H19, 223-9837)

The primary function of this group is to ensure that Digital's products comply with general international regulations. The group monitors regulations, developing and guiding corporate strategy for compliance. They coordinate the efforts of Engineering, Manufacturing, Marketing, and Field Service in meeting regulatory requirements.

This group also provides Digital with an overview of international marketing needs relative to product design and testing. They assess risk and return-on-investment results, making recommendations on issues that concern hardware conformance to these marketing requirements.

You may consult with group members to help you identify reasonable goals in your product design. They can also help you with the implementation of DEC STD 060, *Design and Certification of Hardware Products to National and International Regulations and Standards*, for which the group is responsible. They can help with implementation of DEC STD 062, *Submittal of Hardware Products to National and International Agencies*, which describes all the external agencies to which Digital's products must be submitted.

1.2 INDUSTRIAL DESIGN

Manager: Dick Schneider (HL2-3/J11, 225-6050)

The Industrial Design group develops and maintains product aesthetic designs that have broad applications. Services of this group encompass related aspects of aesthetics, human factors, product recognition, and product-related graphics.

Group Objectives

Aesthetic

- To develop a distinctive and attractive appearance that denotes a high-quality product appropriate to the end-user environment
- To establish and maintain a strong physical resemblance among products throughout the product lines

Human Factors

- To ensure that products for the user are easy to understand
- To ensure that products are convenient, comfortable, and safe to use
- To ensure that the user-product relationship is efficient

Product Recognition

- To ensure that the basic configuration of a product relates well to other products in structure, materials, finish, and physical and mechanical attributes

Product-Related Graphics

- To design and develop product identification graphics such as logos, labels, nameplates, control graphics, and packaging graphics, with attention to the selection and control of color

Industrial Design can furnish you with human factor analyses. They can also help you develop instructional material for non-technical users. Members of the group generate mock-ups, models, and prototypes. They design artwork, documentation, and specifications for all forms of purchased labels, including Class 36 labels.

Contact Industrial Design during the concept phase of user-visible products. They need enough time to study and understand your needs and to relate your product to other Digital products.

1.3 TECHNICAL INFORMATION MANAGEMENT

Manager: Warren Moncsko (ML4-4/T40, 223-4080)

Technical Information Management is the technical controller of engineering information about product and process description and performance. They maintain the quality and security of this information, and develop new methods to provide it to Engineering. The goal of Information Management is for an engineer or other user to be able to access this information so as to speed and ease the making of good technical and business decisions.

1.3.1 Technical Information Process
Manager: Diane Stewart (ML4-2/E90, 223-3025)

This group works on improving the technical information available to engineers through measurement and analysis of technical information needs and of the engineering process.

1.3.1.1 Engineering Metrics
Supervisor: Bill Sutherland, acting (ML4-2/E90, 223-2051)

Engineering Metrics develops and operates the internal Digital systems that measure aspects of engineering design. They work with users to develop, report, and analyze design data. Another focus is design process scheduling, forecasting, and simulation.

Contact these project leaders for more information in their areas:

Metrics development:	Bill Sutherland, 223-2051
Metrics analysis:	Maria Ziminsky, 223-7481
Metrics simulation:	Cynthia Staszko, 223-9504

1.3.1.2 Engineering Information Process Management
Supervisor: Nancy Moore Surrette (ML4-2/E90, 223-3171)

Engineering Information Process Management includes these four major projects:

Engineering Change Order (ECO) Process (Pat Walton, 223-7610) This project's focus is to analyse, define, maintain, and develop Digital's ECO processes, with the ultimate aim of automating them.

Document Control File/Paperless Engineering Documentation System (*DCF/PEDS*) (Susan McElroy, 223-8082) This project is enhancing the Document Control File (DCF) to shift the current emphasis on document status to a focus on descriptive part information. Information can be correlated, referenced, and linked to other systems, which will facilitate decision making and pave the way towards the Paperless Engineering Documentation System (PEDS) of the future.

Revision Management (Bill Buck, 223-9053) DEC STD 012, *Unified Numbering Code: Policy on Part and Document Identification Conventions*, establishes guidelines for revision control within Digital. The Revision Management project involves the adoption of DEC STD 012, Section 0, and assistance in its implementation. The Revision Management project specifies tools needed to integrate the policies of DEC STD 012, Section 0, into the required information systems.

CAD Library Development (Don Call, 223-5871) This project deals with short-term CAD (computer-aided design) library issues, plans strategy for meeting future CAD tool needs, and researches how CAD tool data may be transported between sites with consistency.

1.3.1.3 Engineering Design Information Process
Supervisor: Dick Bubnel (ML4-2/E90, 223-8081)

Engineering Design Information Process defines, documents, and analyzes printed circuit board and mechanical design process and related issues. They aim to speed design development by documenting process flow, establishing release criteria, gathering metrics information, and analyzing processes from a business viewpoint.

Printed Circuit Process Issues (Dick Bubnel, 223-8081) This project seeks to standardize the printed circuit prototyping process and the producibility checklist. They examine processes including silk-screen, logic design, and release coordination, and analyze supporting documentation.

MECAD Process (Jim Travers, 223-3346) Some of this group's issues are the mechanical design release process, the MECAD (mechanical CAD) release process, the Unigraphics user listing, the Unigraphics-to-COM and KPL process, and file naming conventions.

1.3.1.4 Technical Information Operations
Supervisor: John Holt (ML4-2/E90, 223-2455)

The major tasks of Technical Information Operations are the Unit Charge Administration and the CAD Library Operations.

Unit Charge Administration maintains the Unit Charge system, a financial billing system used by project managers and others to track spending by specific projects and tasks. Unit Charge is a powerful financial forecasting tool for understanding present and future business requirements. Contact Susan Hale, 223-5742, for additional information and requests for system use.

CAD Library Operations maintains and supports the various libraries associated with CAD systems used by Engineering and Engineering Services. They receive, generate, check, and distribute library data on new product design, while ensuring that data is consistent and transportable.

Physical Shape Library	Tom Witowski, 223-4242
Assembly Library	Brad Chapin, 223-4185
Schematic Symbol Library	Tom Witowski, 223-4242
Special Features Library	Jerry Best, 223-6604

Technical Information Operations also assigns blocks of part numbers and updates part number data on the Master Parts File. They support metrics development of data input and report generation.

1.3.2 Technical Systems Management
Manager: Carolyn Rodriguez (ML3-6/H27, 223-9087)

Technical Systems Management manages the operational systems required by Engineering to satisfy their technical information needs. One of the most important of these systems is the Engineering Product Library System (EPLS). EPLS is a central source of information about Digital's products. Using a computerized data base, EPLS collects, stores, and retrieves information.

EPLS contains more information on more part numbers than any other data base in the company. The EPLS Master Parts File has nearly all of the part numbers assigned anywhere in the company, with the deliberate exception of those numbers assigned and used exclusively within a single Manufacturing plant. More than 40 specific pieces of data are available for each part number, using on-line data retrieval and batch services.

EPLS also stores information on structured relationships for all parts. For any part number, EPLS can list all of the parts that go into it (the Bill of Materials) and all of the parts it goes into (the Used-On Listing), through various on-line commands and appropriate batch reports. Both Engineering and Manufacturing Bills of Material are included in EPLS.

Management of information for EPLS is illustrated by the flowchart in Figure 6-1. EPLS collects data from such groups as Engineering Services, Specification Control Systems, manufacturing plants, and the Office of the Chief Engineer. The data consists of such items as the Master Parts File (MPF), engineering parts lists, option module lists, the DEC Standard price list, Bills of Material (BOM), and Mean-Time-Between-Failure (MTBF) rate predictions. The data is then supplied to any group requesting information about Digital's products. Such groups include Engineering, Field Service, Sales, Revenue Accounting, Corporate Planning, Manufacturing, and others.

The EPLS Hotline, 223-6430, provides a communications channel for everything from casual inquiries to emergencies. Analysts are available to either respond to user needs immediately, or to pass along comments to the appropriate person. Please use the Hotline to find out more about EPLS.

1.3.3 Technical Systems Development

Manager: Len Beyersdorfer (ML3-6/H27, 223-2542)

This group provides system analyses and design, applications software develoment, and consultation to help make product information available throughout Digital. This information is disseminated primarily through the Engineering Product Library System (EPLS). See 1.3.2 of this chapter for more information on EPLS.

1.3.4 Diagnostic Operations

Manager: Warren Moncsko, acting (ML21-3/T40, 223-4080)

Diagnostic Operations has a dual role. The first role is the functional management of diagnostic engineering, through chairing the Diagnostic Engineering Managers Committee (DEMC). DEMC includes representatives from Central and Product Line Engineering, Marketing, Customer Services, and Manufacturing. The committee is a forum for the discussion and approval of architectual, strategic, and operational diagnostic issues from a systems point of view.

Diagnostic Operations also manages the development of PDP-11 and VAX-11 diagnostics as a system product, in response to the demand from our customers. Our customers have defined the issues as packaging, documentation, and the feedback mechanism. Diagnostic Operations measures its success in the degree of cooperative work toward the implementation of responsive diagnostic products by other organizations.

1.3.5 Office of the Chief Engineer

Managers: Dick Best (ML3-3/H14, 223-2273)
Carl Noelcke (ML3-3/H14, 223-6208)

The Chief Engineer's primary functions are controlling the option module numbering system, processing MTBF (Mean-Time-Between- Failure) data, furnishing specialized or historical data about options and modules, and administering Design Reviews.

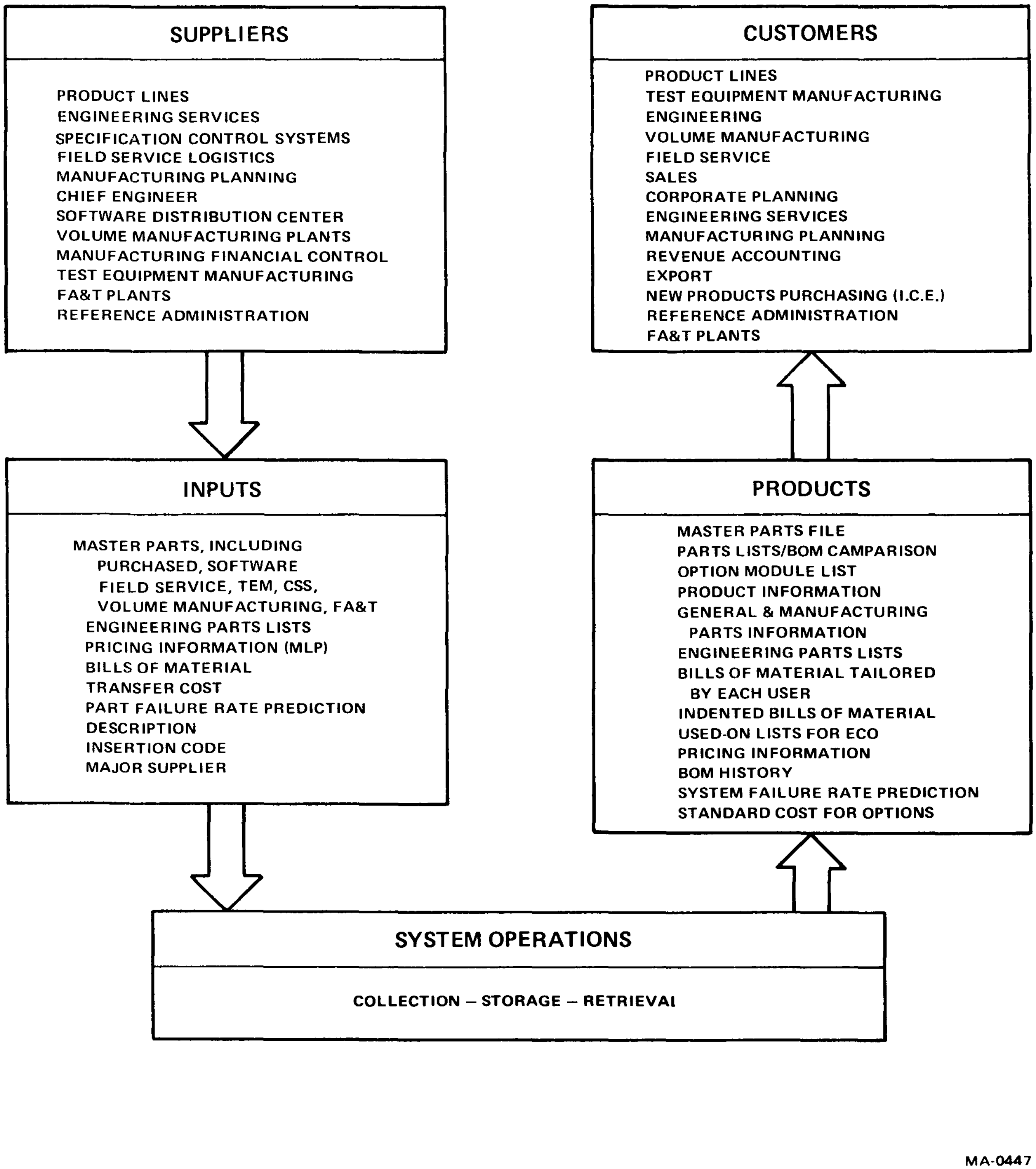

Figure 6-1. EPLS Operations

Responsibilities of the Chief Engineer, Dick Best

- Assigns model numbers and adds them to the Option Module File in EPLS (Engineering Product Library System) along with a description, what it is used on, product category code, voltage code, status, and responsible people

- Maintains integrity of Option Module File by publishing owners' reports for each responsible person (Engineering Manager, Design Engineer, Product Manager, Field Service Manager, Manufacturing Representative, Major Supplier Stockroom Manager) shown on the Option Module File on a quarterly basis and resolving discrepancies in the data

- Provides data to the Master Part File, Corporate Price File, Manufacturing Hi-BOM File, Product Forecasting System, ECO Control, and Drafting

- Approves Printed Circuit Work Requests

- Approves nomenclature and assigns government code for exporting on DEC Standard Price List Maintenance Forms

- Publishes Option Module List (monthly and quarterly)

- Publishes monthly Engineering Newsletter containing technical data and systems and procedures that affect Engineering and Manufacturing personnel

- Provides technical and engineering consultation

- Member of Engineering Review Board, Engineering Committee, and Patent Committee

Responsibilities of Carl Noelcke

- Administers Design Reviews

  (Each product development project that has been assigned a Discrete Project Number and has a well defined completion point is subject to the Design Review Process)

- Receives Design Review plans from Project Engineer and arranges to have Project Engineer present plan to Engineering Committee for approval

- Acts as Secretary of Engineering Committee

  - arranges agenda
  - writes and distributes minutes
  - signs off Digital Standards

- Maintains Reliability Prediction System

- Represents Engineering on Product Safety Committee

Referenced Material

Digital Standards:

DEC STD 007 - *Design Review Process*

DEC STD 008 - *Project Scheduling System*

DEC STD 012 - *Unified Numbering Code*

DEC STD 139 - *Reliability Prediction*

1.4 ENGINEERING SUPPORT OPERATIONS

Manager: Dick Reilly (ML4-4/E99, 223-2982)

Engineering Support Operations has systems and procedures for the creation, control, maintenance, and distribution of part and option information. The organization operates some of these systems and procedures, and monitors most. Groups include Engineering Technical Training, Standards and Methods Control, and Engineering Computer Services. Engineering Information is also responsible for the functional management of all Engineering Services sites.

1.4.1 Standards and Methods Control

Manager: Joe Kurta (ML4-4/E99, 223-8895)

Standards and Methods Control writes and publishes Digital Standards. They administer and support the creation and dissemination of engineering, manufacturing, and other corporate information. Such information includes Digital Standards, A-SP-7665XXX manufacturing specifications, various in-house manuals, and test methods.

Digital Standards are corporate standards. Simply defined, a Digital Standard is a documented agreement among those in the company who have substantial interest in a topic as to how they will handle that topic when it comes up frequently enought to be bothersome. Digital Standards lay out a preplanned course of action to prevent troubles and waste. They reduce costs, reduce development time, promote safety, increase productivity, and foster communication among many organizations. Some Digital Standards establish policy, others state requirements; some describe procedures for performing a task, while others simply provide guidelines.

Areas covered by Digital Standards include Design, Drafting, Hardware Design Assurance, Software and Architecture, Product and Program Management, Manufacturing (workmanship), and others.

Manufacturing-related specifications (7665 series) define internal policies and procedures needed for establishing and maintaining quality control in the manufacturing environment. These specifications cover a variety of topics, from incoming inspection to vendor evaluation, from unit testing and acceptance to automatic component insertion.

Standards and Methods Control also writes and publishes a variety of in-house manuals. Some recently released manuals include *Electrical Design Guide for Printed Circuits*, *Applicon Hybrid Design Manual*, *SUDS Training Manual*, and the *EPLS (Engineering Product Library System) User's Manual*.

Where do you look to see if there are Digital Standards that apply to your area of work? The first place to look is the *EL & 7665 Index*. This index lists, in alphabetical order, over 2,500 entries on subjects ranging from acoustic noise to Zehntel testers. In addition to references to over 200 Digital Standards, the Index also lists the names and order numbers of available manuals. Finally, the Index references over 300 manufacturing specifications (7665 series). One immediate goal is to put the Index on-line so that it can be accessed by computer. In the meantime, you can obtain a copy of the *EL & 7665 Index* by contacting Digital Standards Administration, ML3-2/E56, 223-9475. All of the documents listed in the index are available from Digital Standards Administration.

There is a slight charge for all hardcopy documents. The Index, Digital Standards and 7665-series specifications on microfiche, as well as copies of standards under review, are free.

If your group has established or is establishing policy, requirements, guidelines, or procedures, and you are considering turning these documents into standards, contact Joe Kurta of Standards and Methods Control. The group can help your documents gain the visibility they need through their distribution network. Not only does the group offer writing, editing, and publishing services, they also provide illustrating, administration, and distribution services.

1.4.2 Maynard Engineering Computer Services

Manager: Jim Merksamer (ML1-1/E24, 223-9552)

Maynard Engineering Computer Services provides medium and large system data processing support for Digital's engineering organizations in Maynard. They manage the computer-related assets for Maynard CAD (Computer-aided design) systems and general timesharing systems. Engineering Computer Services has four functional subgroups: CADnet Operations, General Timesharing Operations, System Software Support, and Order Processing.

1.4.2.1 CADnet Operations

Manager: Bob Conlon (ML1-1/E24, 223-3630)

This group provides resource management for Maynard Mill computing systems, primarily involved with computer-aided design (CAD). These systems are also used for general applications in a timesharing environment. Equipment in the CADnet Operations laboratory on ML1-1 includes three KL10 mainframes and a VAX-11/780. The group provides full operations support 24 hours a day, five days a week, as well as weekend on-call coverage.

1.4.2.2 General Timesharing Operations

Manager: Jose Colon (ML4-4/H30, 223-7747)
Operations Supervisor: John Donahue (ML4-4/H30, 223-2880)

This group provides general-purpose timesharing support to Maynard engineering groups, and the Engineering Product Library System (EPLS). The group uses a DECsystem-10 running TOPS-10 and a DECSYSTEM-2060 running TOPS-20. They can provide you with access to the Engineering, Manufacturing, and CAD networks.

You can arrange to use these resources by contacting the people listed above, or your manager can direct you to the appropriate Engineering computer facility for your use. There are many located at various sites throughout Digital. The contact person at each site can give you access to the equipment. He or she can also give you an account number, tell you how to schedule machine time, how to report a machine malfunction, and how to get it repaired.

1.4.2.3 Systems Software Support

Manager: Bob Conlon (ML1-1/E24, 223-3630)

This group provides operation system and network software support for Engineering Computer Services. Kinds of support include analysis of resource performance and consumption metrics, software planning, commodity billing, and general user support. They also provide applications development for Technical Operations.

1.4.2.4 Order Processing/Capital Administration

Supervisor: Barbara Donahue (ML4-4/H30, 223-9375)

This group provides services to assist in the planning, forecasting, budgeting and ordering of capital equipment for many of the different organizations located in the Maynard Mill.

1.4.3 Engineering Services

Functional Manager: Dick Reilly (ML4-4/E99, 223-2982)

Engineering Services provides tools and procedures to convert conceptual and logical engineering data into physical designs. The designs are then turned over to Manufacturing. They provide both computer-aided design and manual design services, including development, documentation, and release support.

The *Engineering Data Services* group provides design data protection and preservation. They maintain the document control file (DCF), document enhancement, archives, reprographics, micrographics (source filming and computer output microfilm), and distribution of media.

The *Engineering Design Library* is a central information source for the protection, preservation, archiving, and transportation of engineering drawings.

Engineering Reprographics provides engineering data reproduction services. This includes hard copy regeneration, microfilm blow-back, and document enhancements. They also provide volume printing of engineering documentation to the Software Distribution Center and mail-in orders.

Engineering Micrographics microfilms new and revised Engineering drawings using 35mm film, which is then mounted onto aperture cards. Duplicate diazo aperture cards are produced from silver negative cards and distributed to over 30 Digital facilities to create and update Engineering documentation aperture card files. To support the field maintenance print set business, photographic enlargements made from silver negative aperture cards are available upon request.

Engineering Services' sites are located throughout the world. However, not all sites presently offer a complete range of services. For a complete listing of all Engineering sites, see Engineering Services in the Digital Telephone Directory.

1.4.4 Model Shop Services (Maynard)

Manager: George Gerelds (ML5-3/E22, 223-2309)

Four groups provide a range of Model Shop services for any one who needs them. The *Stockroom* supplies component parts for your design. The *Mechanical Prototype Shop* fabricates metal, plastic, and wood units. The *Prototype Assembly Shop* assembles prototype modules and subassemblies. The *Production Model Shop* is concerned with model assembly. The specific functions of these groups are outlined in the paragraphs which follow.

Engineering Stockrooms

The various stockrooms stock company-preferred components to avoid the incorporation of obsolete or non-preferred parts into new designs.

Component requirements for a project should be submitted to the appropriate stockroom early enough so that a vendor's delivery schedule will not delay your project. You must supply the stockroom with a parts list showing Digital part numbers (see DEC STD 012, Section 2, *Inventory Class Codes*). You must also supply an engineering charge number and fill out a work order form. Stockrooms will purchase components from vendors, and assemble kits in reasonable quantities. A good rule of thumb is to submit your parts lists just before submitting your new design to the Design Services group.

The Maynard Stockroom (#63) stocks components for prototypes and production models. It also expedites components and software supplies from other stockrooms. Stockroom #63 does not expedite LSI (Large Scale Integration) parts.

Table 6-1 Engineering Stockrooms

Location	*Number*	*Contact/DTN*
ML5-3	#63	Barbara Savoy, 223-3775
MR1-2	#13	Sharon Lindsay, 231-6763
TW	#348	Bill McMahon, 247-2869
ML1-3	#132	Sue Goff, 223-3285
MK1-1	#393	Ben Pakus, 264-7273

Mechanical Prototype Shop: Supervisor: Ed Mayall (ML1-1/E22, 223-2583)

This group fabricates sheet metal, machined plastic, and wood. It also provides machine shop services such as milling, grinding, lathe work, and heat treatments.

The group usually requires two to three days to provide you with a finished prototype, depending on complexity of your design and on the current work load. You must supply the group with sketches or blueprints. You may give verbal instructions, too, but written instructions are better. Because the prototype process often requires several passes, do not order more prototype units than you need.

Prototype Assembly Shop: Supervisor: Helen Grimes (ML5-3/E22, 223-3022)

This group assembles prototype modules, small subassemblies, wirewrap assemblies, printed circuit boards, cable harnesses, and other equipment. Not limited to providing prototypes, the group provides assistance in small-lot production jobs which cannot be handled cost-effectively in Manufacturing. The group will also do breadboarding for you, check for errors in documentation, and advise you on the volume producibility of your prototype.

The group's assembly charges are based on the number of module components and are competitive with outside vendors. You may contact the Prototype Assembly Shop on an informal basis, that is, you may walk in and describe what you want without having to submit formal documentation. Contact the group in the planning stage of your project.

Production Model Shop: Supervisor: Brad Sparkes (ML5-3/E22, 223-3255)

The Production Model Shop builds printed circuit board models and subassembly models (for example, power supplies, power controls, cable assemblies) on request for Manufacturing to compare with production units. The group also generates hand testers for low-volume items, or for items that are not tested on automated module test (AMT), computerized module test (CMT), or standard test equipment.

In addition to building models, the Production Model Shop performs odd jobs that range from building wirewrap boards and cable harnesses to assembling show mock-ups and filling low-volume customer orders. Group members will perform a quality control check on any item upon request.

If you want to use the group's services, you must provide some kind of documentation from which group members can work. Jobs for Digital customers require formal documentation. For other jobs, any documentation will suffice provided it is legible and easy to understand.

When you want ROMs or PROMs blasted, you must supply them, as well as a punched tape or programmed ROM/PROM.

1.4.5 Engineering Technical Training
Manager: Al Pepper (ML4-4/99, 223-8083)

The Engineering Technical Training group provides information, training, and services that will result in a more effective hardware development and design process. They provide state-of-the-art CAD (computer-aided design) tool training in the IDEA and SUDS programs, to meet product development design needs. Acting as a clearinghouse, they identify, develop, and deliver the resources needed to meet a wide range of Engineering's needs in relation to current and future Digital goals.

Computer-Aided Design Training Courses: Engineering Technical Training offers training courses and consulting in SUDS (Stanford University Design Systems) and in IDEA (Interactive Design Engineering and Automation). Norm Rheault (ML4-2/E90, 223-8789) is the SUDS trainer, and Pat Barry (ML4-2/E90, 223-6167) is the IDEA Trainer. Moe Marchand (ML4-2/E90, 223-5235) is trainer for both IDEA and SUDS.

Process Course Development: This function, headed by Don DiMatteo (ML4-2/E90, 223-2438), aids in enhancing the CAD Tool Training program. They develop CAD-related courses, such as the Printed Circuit Design Course and the TOPS-20 User Course.

Training Coordinator (Joy Tucker, ML4-2/E90, 223-9710): The Training Coordinator administers such aspects of the training programs as course enrollment and scheduling, and acts as a resource for internal and external training information.

For more information on CAD training courses, contact Joy Tucker, 223-9710.

1.5 FCC COMPLIANCE PROGRAM

Manager: Dave Brown (ML11-3/T13, 223-2270)

By June 1980, the Federal Communications Commission (FCC) had established requirements for allowable limits on conducted and radiated radio-frequency emission levels for computing equiment, along with dates by which such products must comply. Most of Digital's products are affected by the rulings. The FCC Compliance Program was established to enable Digital to meet these emission requirements.

The FCC set three implementation dates for their rulings:

- By 1 January 1981, all non-exempt products must be labeled with their compliance status.
- By 1 October 1981, products first introduced into production must comply with emission standards.
- By 1 October 1983, all products being manufactured must comply with emission standards.

The FCC Compliance Program has established a labeling process for all equipment, test facilities and scheduling management, and coordinates the FCC program to enable a minimum disruption of engineering and other activities. DEC STD 103, *Electromagnetic Compatibility Hardware Design Requirements*, currently under development, is an important engineering resource. The following are some specific program tasks:

- Construct and operate test sites needed to support FCC conducted and radiated verification tests
- Construct and maintain schedules to ensure efficient use of test facilities
- Develop testing procedures, guidelines, and requirements to ensure rigorous product testing and data collection
- Publish policy memoranda and interpretations of regulations; disseminate technical solutions to avoid redundant design efforts
- Direct the FCC program team, including representatives from throughout Digital; establish task forces as needed to address specific issues
- Provide project management for centralized re-engineering tasks (cables, cabinets) and software to support compliance

Product managers must ensure product compliance at all levels. Each product development group and product line is responsible for its own products. The FCC team is *only* a resource to assist in achieving compliance.

FCC Program Organization

Dave Brown ML11-3/T13, 223-2270	Program Manager; EMC Domain Manager
Mike Cox ML11-3/T13, 223-8005	Test Scheduling Manager: Manages test scheduling for FCC Program-operated test sites. Generates and manages product test logistics.
John Pratt ML11-3/T13, 223-8261	Operations/Project Manager: Operates test sites, brings new sites on line. Project manager for program-funded engineering tasks.
Peter Boers ML11-3/H19, 223-5452	Electromagnetic Compatability Engineering (see Section 1.5.1 of this chapter)
Les Grodberg MS/F19, 223-5740	Corporate Legal Department

1.5.1 Corporate EMI/RFI

Manager: Peter Boers (ML11-3/H19, 223-5452)

This group provides technical expertise for the FCC Compliance Program. They ensure that Digital's products meet international requirements for electromagnetic compatibility (EMC). To do this, the group monitors EMC regulations and tries to influence them through membership in industrial organizations that deal with EMC. Members develop guidelines and standards to guide corporate strategy in complying with EMC regulations.

The group provides consultation on design problems in the EMC area. They integrate Engineering, Marketing, Manufacturing, and Field Service efforts relative to EMC, and determine what quality assurance programs are needed in manufacturing to guarantee consistent EMC characteristics in Digital's products. EMC testing services are also provided. They place special emphasis on identifying the radiated emission characteristics of Digital's products and ensuring compliance to FCC and VDE regulations.

1.6 CORPORATE PRODUCT SAFETY

Manager: Carlton Davenport (PK3-2/H10, 223-7628)

Corporate Product Safety ensures that all hardware products meet the requirements of DEC STD 119, *Digital Product Safety*, and DEC STD 060, *Design and Certification of Hardware Products to National and International Regulations and Standards.*

All applicable products must be UL Listed or Recognized, be Product or Category certified by the Canadian Standards Association (CSA), and comply with International Electrotechnical Commission (IEC) 435. Furthermore, for products marketed in Germany, the appropriate VDE requirements must be met.

Listing, Recognition, and Certifications are always obtained through the Product Safety Group. You should subject your product to Product Safety Reviews at the conceptual (Phase 0), breadboard, and prototype stages, to establish applicability. The group will consult with the engineer on Product Safety design requirements, review and test the product for compliance with Digital Standards, and obtain all UL Listings, CSA Certifications and similar test house approvals. You will be required to supply Product Safety with product specifications, documentation, and samples for testing.

The Product Safety Group also investigates all potential product safety problems. You are required to support all such investigations regarding your product until all problems are solved.

Corporate Product Safety also supports Manufacturing over the life of a product, to ensure that a product continues to be safe, to meet applicable regulations, and to maintain test house certification.

2 EXTERNAL RESOURCES

Manager: Henry Crouse (ML1-5/B98, 223-2610)

External Resources handles all of the purchasing and distribution needs of Digital. This runs the gamut from sourcing raw materials and parts to distributing and shipping final products. Groups described here include Corporate Purchasing, Corporate Distribution, and Technical External Resources.

2.1 CORPORATE PURCHASING

Manager: Jack Batten (ML1-5/B98, 223-3238)

Corporate Purchasing assures supply, competitive cost, and timely delivery of optimum quality materials and services. They coordinate the development of suppliers and make sure that Digital presents one part number, one standard cost, and one face to the suppliers.

Corporate Purchasing also influences strategic business decisions. They participate in the selection of vendors and materials to meet product, design, manufacturing, and administrative goals. The organization also supports Field Service and Marketing, and ensures a formal make-or-buy decision process at all levels in Digital. Whenever practical, actual buying is decentralized to Purchasing groups linked to major Digital organizations. Corporate Purchasing conducts formal training programs and provides guidance on purchasing strategy, policies, and systems. For further information, contact Barbara Birt, ML1-5/B98, 223-2624 or 223-3124.

2.1.1 Engineering/New Products Purchasing

Manager: Tom Cavanaugh (ML21-1/T31, 223-4204)

The group serves the Northeastern engineering community with these distinct services: Tactical Support Purchasing, Project Purchasing, Project Materials Management, Software Purchasing, and Consulting Acquisitions.

Tactical Support Purchasing services Engineering's everyday parts and equipment needs. These include inventory parts for breadboards and prototypes, new items, and out-of-stock items. They handle consultant, maintenance, and service agreements. They can also provide rentals of equipment and capital equipment such as testers. The group will also assist you in locating sources for engineering support materials. Finally, the group can find out who makes any part.

To assist you, the groups needs specification details, part numbers, and catalog data if available. They also need quality standards, if applicable. An authorized Internal Purchase Requisition is also necessary for the group to do business with you. This authorizes the group to commit to a Purchase Order with an outside vendor. It must be completed by the requisitioner with all the necessary signatures. Without this information, order placement may be delayed. For more information on what is required of you, contact the person in your local area from this list:

Rich Bellefuille (HL, 225-4422)
Phil Buscemi (ML5-3/R13, 223-5153)
Tom Culkin (TW/B15, 247-2645)
Jim Ebrecht (LM, 231-4604)
Dave Emus (ZK, 264-8071)
Maureen Hughes (CX, 522-2111)
Phil Terry (MK, 264-5649)

Contact the group whenever an engineering stockroom can't supply your needs. For common breadboard components, it's possible that the material will be in stock.

Because it costs Digital about $35 to place an order, administer it, and generate a check to pay the vendor, it makes sense to group your small items together whenever possible.

Project Purchasing works with design groups to source all new components including fabricated plastic and metal items. The group is organized by commodity specialty, handling active devices, passive devices, fabrication, and plastics.

The group establishes cost-effective sources, evaluating component and metal parts availability, lead time, and the capacities of outside sources. They communicate sourcing risks to both Manufacturing and Engineering, recommending effective risk management. Project Purchasing can also negotiate the most favorable preliminary standard cost, reflecting the proper balance among quality, technical conformance, and expected volumes of lot sizes. The group can also provide a "value analysis" using their internal resources or the vendor base.

Contact the group early in the concept stage of your project. They need sketches or preliminary line drawings with essential dimensions and specifications. The precise format of these requirements is not important in the early phases of your project. For more information, contact:

Bill Annessi (MR1/P71, 231-6110)
Tom Cavanaugh (acting) (ML21-1/T31, 223-3003)
Matt Habinowski (ML5-3/R13, 223-5878)
Lino Mion (ML5-3/R13, 223-2997)
Ulf Stoeckelmann (LM, 231-5139)
Charlie Sullivan (TW/B15, 247-2628)
Alan Worrell (CX, 522-2134)

Project Materials Management exists to aid design engineers in obtaining, controlling, and planning material for prototype builds. They act as an interface to Project Purchasing. As a project-oriented group, Materials aids in documentation control at the preliminary stage by using a PCA (Purchasing Change Authorization) system. The group also structures and maintains, by way of the Parts Lists, an engineering Bill of Materials using software developed by Engineering New Products Purchasing specifically for this purpose. They maintain a product materials cost data base. Finally, the group drives processes for the timely resolution of materials issues among Manufacturing, Engineering, Specification Control Systems, and the Manufacturing plants.

To help you save valuable project time, the group needs an Engineering Parts List, documentation (format unimportant), a willingness to work with the Purchasing Change Authorization (PCA) System, and an Engineering Business Plan (see DEC STD 130) for a new product. Contact them during the concept stage of your product. For more information, contact:

Vic Bellemare (ML5-3/R13, 223-8372)
Charlie Sullivan (acting) (TW/C15, 247-2628)

Software Purchasing assists in locating and obtaining software packages from external sources.

The group acts as a clearing house for externally developed software (do we have license agreements? who uses it? should we acquire it?). They also handle all associated contracts, licenses, and agreements.

Software Purchasing would like to be involved in the concept stage of your project, or as soon as an outside software acquisition is considered. They need a copy of the functional specification and your work plan to expedite acquisition. For more information, contact Ted Prentice, ML21-1/T27, 223-9135.

Consulting Acquisitions assists internal users in the procurement of outside consulting services. The group can assist you in vendor selection (using its outside vendor skills inventory), preparation of work statements, negotiation of terms, conditions, and rates, and contract drafting and legal review. They can also provide all purchase orders for outside consulting services. Please contact Consulting Acquisitions whenever you are considering the use of outside consulting services.

Supervisor: Noel Negroni (ML22-1/T59, 223-2694)
Technical: Steve Kuchun (ML22-1/T59, 223-4142)
Management: Sue Gendron (ML22-1/T59, 223-9133)

2.1.2 Corporate Purchasing/Supply Base Management

Manager: Tom Grablick (ML21-1/P66, 223-2614)

This group prepares 5-year Business Plans for purchasing major commodities and critical raw materials. They ensure that suppliers have the capacity to provide for Digital's expanding material requirements.

The primary responsibilities of the group include coordinating all purchasing activities of today and the next 5 years and ensuring strategies are in place to improve the dollar value of expenditures under contract. Furthermore, the group attempts to reduce raw material and material acquisition costs, measure supplier performance, enhance buyer knowledge, and allocate resources and material.

2.2 CORPORATE DISTRIBUTION

Manager: Carl Kooyoomjian (ML1-5/B98, 223-9735)

This group plans, implements, and directs the efficient flow, storage, and handling of raw materials, in-process inventory, and finished goods from their point of origin to their point of consumption. They have representatives in Digital's plants, product lines, subsidiaries, and administrative groups.

The primary focus of Corporate Distribution is on making an efficient distribution network throughout Digital. Elements of the network include transportation, field distribution centers, warehousing operations, associated systems for communications and control, handling and storage methods, and packaging problem solving.

To assist you, the group can provide a profile of their product design criteria, and an estimate of warehousing and transportation costs and trade-offs. Finally, the group can give you an understanding of the impact of distribution costs on the end user.

If your product needs new distribution schemes, contact the group during the design phase of product development by calling Darlene Hoover, NR1-2, 234-4375.

Questions which must be considered for any new product include: Can the product be stored in our existing warehousing systems? Will a slight design change reduce the storage space required? Can the product be easily handled by Digital and external personnel and equipment? Is the product designed within the requirements for transportation? Can we move the product cost-effectively, safely, and with a minimum of product damage?

Industrial Packaging (manager: Larry Nielsen, ML8-4/B96, 223-2588) designs shipping packages for many different applications. They create package designs for shipping piece parts between facilities, for shipping subassemblies, and for moving products within a facility. They also create package designs for products purchased from vendors, Field Service support, and package designs for shipments to customers.

Industrial Packaging also works closely with Purchasing to evaluate new packaging materials for use by Digital. They evaluate vendor packaging, and build prototypes of new product packages. The group coordinates site activities for on-site packaging engineers, and supports most Digital facilities with centrally run cross-plant projects.

Contact this group when you need shipping packages designed. Members will provide written cost and schedule quotes, and help you develop packing procedures. They will also perform the component engineering function in generating purchase specifications for all packing materials.

They are a service group and need funding well in advance of first shipments, to be of maximum benefit to you. A year ahead of first shipment is not too early to contact them.

2.3 TECHNICAL EXTERNAL RESOURCES

Manager: Don Metzger (NR1-5/B98, 234-4897)

Technical External Resources' goal is to ensure that Digital uses components that provide the best performance, lowest cost, and readiest availability for building cost-competitive, quality products.

The organization provides technical support and consultation to Manufacturing and Engineering on the application and selection of purchased components. They provide documentation to ensure that parts can be procured and tested and are compatible with manufacturing processes.

Technical External Resources is composed of three coordinated efforts: External Technology, Design Component Engineering, and the Regional Technical Offices. These three groups unite to support planning, technology strategies, and new product development activities.

2.3.1 External Technology

Manager: Paul Nix (NR5/A1, 234-4898)

External Technology is made up of Corporate Component Engineering, Specification Control Systems, Component Assurance and Reliability, Training and Development, and two laboratories, the Component Technology Lab and the Evaluation Lab.

2.3.1.1 Corporate Component Engineering
Manager: Paul Nix (NR5/A1, 234-4898)

Corporate Component Engineering facilitates product development by providing a new part introduction process and a wide range of technical support. This support includes:

- Part and vendor selection
- Part qualification and characterization
- Reliability and quality analysis
- Technology consulting
- Regulations (national and international) monitoring equipment and components
- Design and development of test
- Vendor base management and development

2.3.1.2 Specification Control Systems
Manager: John Peachey (NR5/M2, 234-4950)

Specification Control Systems is a central repository containing a wealth of purchased parts information. They ensure the availability of technically accurate purchase specifications to facilitate the design and manufacture of Digital products. They provide the data base tools and controls to enable Engineering and Purchasing to select, test, and procure quality components. Specification Control System's primary focus areas include:

Digital Part Numbers: Each properly completed and approved Part Number Request Form (PNRF) is assigned a Digital part number.

Purchase Specification Generation: The group researches, writes, and edits specifications to established formats.

ECO Processing: The group researches, writes, and processes ECOs (Engineering Change Orders) to purchase specifications.

Electronic Data Processing Entries: Purchased parts data are coded and entered into the Purchase Specification Data Base and are batch-processed daily into EPLS, the Engineering Product Library System.

Purchase Specification Distribution: Purchase specifications are distributed via microfiche (updated weekly) and microfilm. These are distributed to reproduction and microfilm areas and to individual departments.

Component Index Books: The group writes, edits, publishes, and distributes these books, which fall into three categories: Multi-Class, 90 Class, and FCD (Functional Code Descriptor). All indexes are updated periodically and are available to you.

Bulletin Listing All New and ECOed Part Numbers: Every two weeks the group publishes this document with all numbers recently assigned (with related data). It also includes recent ECOs received (with related data).

Incoming Inspection Procedures: These procedures are maintained under ECO control and distributed on microfilm and microfiche.

ROM/PROM Coordination: The group assigns pattern numbers, supplies "how to" information for documenting patterns, and coordinates the information with the Design Library, the LSI Test Center, and vendors.

VSMF (Visual Search Microfilm): These are microfilm cartridges containing most vendor catalogues. By providing a vendor's name, you can be supplied with vendor address, phone number, local sales office and phone number, a list of products offered, and a catalogue sheet of these products. If you know what type of commodity you want, the VSMF can supply you with information about which companies manufacture it, and catalogue sheets from those companies. The VSMF also contains Military, ASTM, and UL Standards.

Qualified Vendor Listing: This information is sorted by Digital Part Number and available on microfiche machines. No hard copy distribution is available.

Purchased Parts Lists: This information is sorted by vendor part number and name and available on microfiche machines. No hard copy distribution is available.

Vendor Code File: This file provides you with the address, phone number, and vendor code number of each Digital supplier.

The group needs complete specification information from you in order to assist you. Sometimes you may be asked for additional component and vendor information to complete your purchase specification. You will be asked to review and sign off a finished specification. Give the group sufficient lead time to establish priorities for completion, review, and approval of the specification.

A convenient "one-stop-shop" method of having your *Part Number Request Form* approved is to leave it and any attached data with Component Engineering. Component Engineering will arrange full approval and submit the PNRF to Specification Control Systems for part number assignment. If you desire, you can bypass the "one-stop-shop" method and obtain approval signatures and part numbers without assistance.

The following Digital Standards will help you do business with Specification Control Systems:

> *DEC STD 012, Section 0 – Unified Numbering Code*: All purchased parts must reflect a Digital-assigned part number before parts lists can be finalized, Purchasing can order, and inventory control can process material.
>
> *DEC STD 055 – Purchase Specifications*: This standard establishes the general instructions and responsibilities for the preparation and control of Digital Purchase Specifications.
>
> *DEC STD 100, Section 2 – ECO Procedures*: This standard establishes the procedures for writing, obtaining approval, and submitting the ECO to the Purchase Specifications ECO Coordinator.

Copies of Digital Standards are available from Digital Standards Administration, ML3-2/E56, 223-9475.

For more information, contact: Jim Boice (NR5/M2, 234-4951)
Carl Bull (NR5/M2, 234-4952)

2.3.1.3 Component Assurance and Reliability

Manager: Joe Belliveau (NR5/E2, 234-4920)

Component Assurance and Reliability develops quality strategies to ensure the effectiveness of the Incoming Inspection process, and to improve the quality of purchased components.

2.3.1.4 Component Technology Laboratory
Manager: J.P. Keller (NR5/E21, 234-4949)

Typical activities of the Component Technology Laboratory include the evaluation and characterization of materials, devices, and other parts, failure analysis, and the development of solutions for technical problems.

The Laboratory's customers include Manufacturing, Engineering, Field Service, Design Component Engineering, Supply Base Management, and Corporate Component Engineering.

2.3.1.5 Component Evaluation Laboratory
Manager: Stan Bednarski (NR5/F2, 234-4868)

The Component Evaluation Laboratory provides a wide range of services to a broad customer base. The Laboratory is comprised of three groups, the Qualification Laboratory, Test Engineering, and the Integrated Circuit Test group. Their services include test equipment design and development, evaluation and qualification testing, and test program and software generation.

2.3.1.6 Training and Development
Supervisor: Don Dunn (ML6B-3/E21, 223-6614)

Training and Development works to strengthen Technical External Resources through the employee and organizational development process and by coordinating technical training. They sponsor orientations for newly hired component engineers, and vendor technical seminars to disseminate state-of-the-art technology information.

2.3.2 Design Component Engineering
Manager: Leo Tiernan (NR5/A5, 234-4879)

Design Component Engineering provides many services to Design Engineering. These include direction on new or preferred technologies, vendor liaison, testing methods, and qualification requirements. They assist in getting your product to Manufacturing by interacting with Purchasing, Specification Control Systems, Incoming Inspection, Process Engineering, and Manufacturing. The Design Component Engineer maintains a knowledge of component group activities outside the domain of Component Engineering, including groups working in the areas of fabrication, metals, chemicals, LSI, and others.

2.3.3 Regional Technology Offices

The Regional Technology Offices are located in Tokyo, Japan, and Mountain View, California. They evaluate and disseminate engineering data on technology developments, provide on-site management for new product development, and support the specific programs and project needs of advanced development groups in Engineering and Manufacturing.

Contact the Regional Technology Offices through Design Component Engineering (Leo Tiernan, NR5/A5, 234-4879).

CHAPTER 7

PROCESS TECHNOLOGY DEVELOPMENT
Manager: Will Thompson (QI-1/E21, 280-7300)

1 PHYSICAL INTERCONNECTION TECHNOLOGY
Manager: Joe Chenail (QI-1/B17, 280-7247)

The Physical Interconnection Technology group provides the advanced technology and manufacturing process development engineering required to ensure high volume producibility of computer components and subsystems.

A staff of technical innovators, skilled in manufacturing and process development, and in test systems hardware/software development and applications, forms a major portion of the applied Engineering and Manufacturing Technology Development Group located at the corporate technology cluster in Andover, Massachusetts.

This group should be your initial contact during the concept development phase of product design, since they can provide the "chip to backplane" technical information necessary to assure that ongoing or planned product programs will enter the product life cycle with the best internally available technology.

More detailed information and specific technology development descriptions can be obtained by contacting any one of the individuals listed below:

Materials and Assembly Process Technology (MAPT): George Katronge (BP2, 235-3216)

Manufacturing Test Systems (MTS) Technology: Dick Albright (QI/B17, 280-7238)

Advanced Manufacturing & Engineering Operations (AME): Peter Murphy (QI/B17, 280-7248)

For technologies not specifically listed above, contact the Physical Interconnect Group Manager.

2 PROCESS INFORMATION CONTROL SYSTEMS
Manager: Lou Klotz (QI1/E21, 276-7400)

Process Information Control Systems develops and implements the concept of the collection, processing, and dissemination of process control information as applied to manufacturing processes.

They aim to increase the efficiency of manufacturing operations by interconnecting plant management information systems and by promoting the common use of data. Process Information Control Systems is made up of three major groups:

2.1 PROCESS CONTROL SYSTEMS

Manager: John Ardini (QI1/E18, 276-7589)

This group develops software designed to reduce manufacturing costs and cycle times, and to improve quality. In conjunction with the other Process Technology Groups, Process Control Systems seeks, develops, and implements the applications control software required for new manufacturing technologies.

2.2 NETWORK SYSTEMS

Manager: Marv Horovitz (AC/E77, 232-2546)

Network Systems provides the network architecture required to support Process Information Control Systems. They provide the technical expertise for successful implementation of new developments in the manufacturing environment.

2.3 INFORMATION SYSTEMS

Manager: Bob Lynch (QI2/D21, 276-7451)

Information Systems has a dual function. They provide Management Information Systems for the Process Technology group, through support of hardware and software systems for operations. The group also provides software and software tools development for advanced development projects, including the interconnection of non-Digital devices, language evalution, and the interchange of data between engineering and manufacturing.

2.4 MANUFACTURING TEST APPLICATIONS

Manager: Louis Klotz (QI1/E21, 276-7400)

This organization consisted of six major groups: Automated Manufacturing Systems, Module Test Programming, Manufacturing Test Support, Simulation and Test Applications, Power Supply Test Systems, and the MTA Testability Committee.

This group is in the process of decentralizing to the manufacturing groups. For information concerning these areas, contact your Group or Product Line Test Strategist.

3 COMPUTER-AIDED DESIGN (CAD)

Manager: Pete Straka (ML21-3/T40, 223-3189)

Computer-Aided Design (CAD) is responsible for tools and new processes for the physical design of chip carriers, boards, and backplanes. Physical design is that part of the engineering process that follows logic design and global partitioning, and precedes initiation of the manufacturing build process.

Broad elements of responsibility are:

- CAD Systems
  - CAD Engines
  - CAD Interfaces

- Auto Tools

- Tool-Technology characterization

- Pilot Design Capability
  - New tools and design processes
  - New technologies

The goal of the CAD group is to have characterized tools available for in-place systems when a product design is initiated. If product design requirements precede completion of this event, the CAD group will enter into partnership with the product and technology developers to evolve needed tools and processes.

3.1 CAD ENGINEERING AND APPLICATIONS (CADEA)

Manager: Bill Wehring (ML3-5/T28, 223-3223)

CAD Engineering and Applications (CADEA) develops and distributes computer-based tools for the physical design and layout of backplanes, modules, ceramic substrates, and gate arrays. They work closely with users to respond to new projects and technologies. They also implement general-purpose enhancements to streamline the layout process and protect Digital's investment in CAD systems hardware, such as system foundations, interfaces, layout tools, and automatic design aids. CADEA contains three groups:

Layout Design Applications, supervised by Fred Haefner (ML3-5/T28, 223-2802), is responsible for all physical layout applications.

CAD Systems, supervised by Bob Anderson (ML3-5/T28, 223-5930), is responsible for CAD Systems including system architecture and operating systems, data bases, and design verification and analysis tools.

Site Support, Test, and Release, supervised by Tig Richardson (ML3-5/T28, 223-3325), is responsible for insuring the usability and integrity of the CAD tools it supports at all Engineering sites, and for working closely with local site support people, as well as the control, distribution, testing and archiving of CAD software system.

CAD Engineering and Applications provides services to Digital's entire engineering community. Their purpose is to provide the engineer with the finest, most cost-effective tools available. They work closely with engineering, especially in regard to new technologies at Digital. CAD tools can be both a big benefit and a big limitation. Early communication is a key ingredient in success, through the removal of limitations or in the selection of appropriate alternative design solutions.

3.2 AUTOMATED DESIGN SYSTEMS
Manager: Don Yelton (ML3-5/T28, 223-3437)

Automated Design Systems develops software used to automate the layout and engineering analysis of macro-electronic hardware (ceramic hybrids, printed wiring boards, and backplanes). They also define and implement software to interface macro-electronic CAD systems to other engineering and manufacturing systems. The department consists of two groups:

Automated Design and Analysis Tools, headed by Brian Gordon (ML3-5/T28, 223-8519), is responsible for implementing software to automate the engineering layout and analysis of macro-electronic hardware.

System Interfaces, headed by Don Yelton (acting, ML3-5/T28, 223-3437), is responsible for implementing data interfaces between macro-electronic CAD systems and other engineering and manufacturing systems.

3.3 DESIGN SYSTEMS DEVELOPMENT
Manager: Andrew Matthews (ML4-4/E99, 223-8489)

Design Systems Development provides new CAD software tools, both purchased and developed, and fully characterized design processes to meet the changing needs of physical design implementation used in the Engineering design process. Design capabilities cover interconnect technologies including ceramic hybrids, printed wiring boards, backplanes and other products. Three groups make up Design Systems Development:

Interactive Systems Development, headed by Will Anderson (ML3-5/T28, 223-2742), is primarily responsible for the development of the VAX-based "professional workstation" for engineering design and implementation. They currently focus on systems foundations, and interactive layout software for printed wiring, gate array, ceramic hybrid, and backplane technologies.

Advanced Design Services, headed by Tom Surette (ML4-5/T38, 223-6202), is the CAD user group responsible for intensive CAD tools, design technology, testing and characterization, new CAD process definition, and pilot production use of tools and design technologies. They have the skills and resources to do experimental design layouts beyond current process capabilities.

Advanced CAD Development, headed by Ken Coley (ML4-4/E99, 223-8762), is responsible for CAD capability planning and needs assessment in consultation with Engineering groups, for the advanced development of CAD software and techniques, and for the acquisition of external software.

3.4 CAD PROGRAM OFFICE
Manager: Pete Straka, acting (ML3-5/T28, 223-3189)

The CAD Program Office insures that CAD activities are included in and managed as elements of programs to achieve strategic Process Technology Development goals. The Program Manager insures that the technical, user benefit, and financial aspects of CAD programs are planned, reviewed, measured, and reported, that interdependencies are understood and cross-functional commitments are negotiated, that all the activities of the program are properly coordinated and directed towards the desired results, and that any problems are understood, reported, and resolved. The Program Office is a major contributor to strategic and long-range planning within the Computer-Aided Design group.

4 POWER AND PACKAGING TECHNOLOGY DEVELOPMENT

Manager: Henk Schalke (ML11-3/H19, 223-7103)

Power and Packaging Technology develops base technology, tools, and components for the power and packaging domain. They provide technical consultation and advanced product and process development for the following technology segments:

- Power supply design
- Signal integrity
- Transmission circuits and media
- Power supply test
- Thermal design
- Mechanical CAD/CAM
- Acoustic design
- Materials and mechanical processes
- Enclosure design

4.1 MECHANICAL TECHNOLOGY

Manager: Frank Grimaldi (ML8-3/T13, 223-4177)

Mechanical Technology provides consulting services to address product design and manufacturing process needs in mechanical technologies. Mechanical Technology consists of the following groups:

- Environmental Engineering (product environmental capabilities)
- Advanced Materials and Processes (product/process materials and finishes).
- Product Acoustics (product acoustic noise)
- Solid Mechanics (statics, dynamics, kinematic analysis)
- Thermal Engineering (product cooling)

Mechanical Technology's personnel work as contracted members of new product design teams to help develop quality products with mechanical performance capabilities compatible with manufacturing process goals and methods. They also perform advanced and tool development tasks, maintain Digital Standards, develop design guidelines, provide technical seminars, track external regulations, and participate in appropriate industry associations in their disciplines. Mechanical Technology groups also maintain and operate laboratories to support mechanical technology needs:

Laboratory	*Manager*
Acoustics	Bob Lotz (ML8-3/T13, 223-5774)
Environmental Engineering	Frank Grimaldi (ML8-3/T13, 223-3349)
Thermal Engineering	Robert Hanneman (ML8-3/T13, 223-3349)

The Industrial Packaging laboratory can also be helpful with your mechanical design work. See the section on Corporate Distribution, Section 2.2 of Chapter 6, for more information.

Contact Mechanical Technology as early as possible, to ensure that recommendations and design details can be addressed with a minimum of disruption to prior work or frozen design factors.

4.2 SIGNAL INTEGRITY ENGINEERING

Manager: Don Marshall (ML6A-2/T45, 223-3276)

Signal Integrity Engineering develops and provides engineering support in digital interconnections. They are involved in the development of advanced interconnect techniques and high-speed serial data transmission. They develop simulation and measurement tools and conduct analysis of energy transmission, propagation, and reception. Group members present a corporate technical resource for consultation on electrical integrity over a spectrum of media and devices. Finally, they provide engineering support for the Unibus, Massbus, and other traditional busses.

4.3 CENTRAL POWER SUPPLY ENGINEERING

Manager: Art Rudin (ML8-4/E86, 223-1945)

Central Power Supply Engineering designs and introduces power supplies, power controllers, regulators, battery back-up modules, and power distribution assemblies into production. They also reduce costs and enhance products by adopting different product technologies.

4.3.1 Power Integrity Engineering

Supervisor: Frank Loya (ML8-4/E86, 223-6328)

Power Integrity Engineering is primarily concerned with ac power, its distribution, protection, control, quantity, and quality, to ensure reliable operation of equipment and systems. They also maintain the following Digital Standards:

DEC STD 002	*AC Power Wiring, Grounding Receptacles, and Nameplates*
DEC STD 122	*AC Power Line Standard*
DEC STD 123	*Power Control Bus Standard*

Copies of standards can be obtained by calling Digital Standards Administration, ML3-2/E56, 223-9475.

4.3.2 Storage Systems Power Supply Development

Supervisor: Len Salafia (ML8-4/E86, 223-6804)

This group provides power supply design development and support for Storage Systems Product Development groups.

4.4 POWER CONDITIONING TECHNOLOGY

Manager: William Hazen (ML8-4/E86, 223-4679)

Power Conditioning Technology is responsible for the advance development of power supply technology for all of Digital's products. Through the Technology Management function, they work to merge product needs with power technology opportunities and to provide technology transfer for a timely introduction into product development. They also direct the Power Conditioning Research and Advance Development Committee, provide technical training and development, and manage external research projects.

4.4.1 Power Conversion Technology and Tools
Supervisor: Trey Burns (ML8-4/E86, 223-7626)

Power Conversion Technology and Tools monitors Digital's power needs, and does advance development relating these needs to power conditioning technology. They track this technology in industry, university, and government-associated research activities, and provide analysis and simulation tools for power supply and power system development.

4.4.2 Power Circuit Technology
Consultant Engineer: Jim Gregorich (ML8-4/E86, 223-5173)

Power Circuit Technology does advance development relating Digital's needs to power circuitry, device, and component technology. They provide consultation in these areas for research activities.

4.5 CENTRAL MECHANICAL ENGINEERING
Manager: Don Staffiere (ML11-4/E53, 223-8656)

The Central Mechanical Engineering team develops and implements new mechanical packaging concepts in cabinets and enclosures. Members design, develop, and maintain cross-product enclosures. They also upgrade and modify existing products to meet evolving international safety and regulatory requirements; they analyze, evaluate, and resolve mechanical enclosure problems identified by Field Service and Manufacturing. They also support the manufacturing process for mechanical assemblies. Additionally, the team develops guidelines and standards for cabinet cabling and stability. They work with Thermal and Acoustical Engineering to establish cooling and acoustical guidelines for enclosures, and disseminate information for all mechanical engineering groups.

Team members also serve in a central mechanical engineering resource pool to assist in the development of new products on a project-by-project basis. They furnish consultation on packaging design problems encountered by other groups. Mechanical engineering expertise on the packaging of power supplies is also provided.

5 MECHANICAL CAD
Manager: Dick Anderson (ML11-3/H19, 223-3041)

5.1 MECHANICAL COMPUTER-AIDED ENGINEERING
Manager: Nick Wells (ML11-3/T13, 223-2557)

This operations function provides a multi-user Unigraphics CAD/CAM (computer-aided manufacturing) system facility for product and technology development in the Power and Packaging Technology groups. This facility is one of several similar facilities in the Maynard Mill complex.

5.2 MECHANICAL CAD/CAM TECHNOLOGY
Manager: Art Aronovitz (ML5-1/E31, 223-4805)

This group's goal is to integrate the engineering and manufacturing functions of mechanical CAD/CAM, and to subsequently spread the technology throughout Digital. This is accomplished by maintaining a computer laboratory used for both development and production. Development applications include pure Research and Development, training, system engineering, and special software generation. Production use includes design engineering, tool engineering, and N/C (numerical control) programming.

6 PROCESS TECHNOLOGY DEVELOPMENT PROGRAM MANAGEMENT

Manager: Len Greaney (QI1/B22, 276-7310)

The Program Management group ensures that the Process Technology Development organization properly controls its programs and projects, and communicates plans and activities to Engineering and Manufacturing customers.

Advanced Producibility, managed by Bernie Macdonald (QI1/B22, 276-7280), is a cross-product and cross-systems oriented group that supports Engineering and Manufacturing through DEC STD 030 and the Producibility Handbook.

DEC STD 030, *Module Manufacturing Standard*, establishes the manufacturing and technical requirements for designs and practices for all production printed wiring boards and modules. The standard contains basic design rules to ensure that printed circuit designs can be manufactured quickly and economically.

Advanced Producibility develops tools and systems for applying design and documentation rules. They supply Design Engineering and Engineering Services with information on the requirements and benefits of Producibility. They assist and advise other groups within Process Technology Development on the producibility on new products and processes.

CHAPTER 8

PRODUCT LINE GROUPS

Digital's three major product line groups are Commercial Products, Computer Products, and Technical Products. Each major product line group is made up of a number of discrete product line groups. The product line groups have been described as small companies within the larger corporation, each responsible for its own marketing, advertising, finance, production operations, and engineering (when needed), with a primary responsibility for marketing and market planning.

Most product line groups are based on a particular industry and its needs. The OEM (Original Equipment Manufacturers) product line groups, for example, exist to expand Digital's repertoire of OEM customers and to provide them with the support they need. ECS, the Education Computer Systems Group, caters to the education market: schools, universities, and armed forces training facilities. By adopting the Digital products that fit individual marketplaces, product line groups are able to provide a wide range of specialized equipment and services geared to solving a customer's data processing problems.

Product line groups structure their product offerings around the needs of their particular customers. This structuring is based on a knowledge of how customers do business, what their problems are, and how our products can be designed to solve their problems and help them run their businesses more efficiently.

Therefore, it is very important that you have a clear understanding of customer needs. A product's capabilities and applications are valuable only if they are marketable. State-of-the-art equipment will remain just "art" unless there exists a customer for such equipment. Obviously, design engineers cannot design and implement products in a vacuum. They must look at products from the perspective of the customer.

Products which truly serve the needs of the marketplace are more likely to happen when communication is developed between Engineering and the product line groups. Most of this communication and coordination of efforts is performed by Product Managers from Central Engineering. But they can't do it all. For this reason, it would greatly benefit you and the company if you gained some knowledge of the ultimate use and destination of products developed at Digital.

The following pages contain descriptions of the product lines, the products they market and their applications, and whom to contact for more information.

1 COMMERCIAL PRODUCTS GROUP

1.1 COMMERCIAL OEM GROUP
Manager: Dave Schroeder (MK1-2/H32, 264-5502)

This group sells small business computers through other organizations that add applications and resell the systems to small businesses.

The group is the main OEM (original equipment manufacturer) supplier in the commercial marketplace. Through this channel, the Commercial OEM Group has acquired 10 to 15% of the small business computer market, primarily in the general-purpose data processing environment. The major strengths of the group are in the size of its current distribution network (over 650 commercial OEMs), the availability of a family of compatible products, and the breadth of Digital's Field Service network.

A compatible family of DEC Datasystems running on PDP-8s, PDP-11s, and VAXs are available from the commercial OEM group. They also offer development tools for many applications, and some basic accounting application packages.

The group evaluates and develops marketing programs, support programs, and OEM policies on behalf of the entire Commercial Products Group. OEMs are selected by an OEM Review Committee following analysis of a prospect's marketing plans, financial statements, and cash flow figures. Commercial OEMs who choose to apply and who meet Digital's certification criteria are known as Authorized Digital Computer Distributors.

1.2 TELECOMMUNICATIONS INDUSTRY GROUP
Systems Engineering
Manager: Bill Munson (MK1-1/D29, 264-7436)

The Telecommunications Industry group (TIG) supports Digital's business with worldwide telecommunications companies, including operating telephone companies, telephony research organizations, postal telephone and telegraph administrations, and telephone equipment manufacturers. The Systems Engineering group encompasses the following activities:

- Product planning
- Technical support to Sales and Marketing
- Project, program, and product management of TIG-funded engineering activities
- UNIX (trademark of Bell Laboratories) engineering and field/internal liaison
- Applications consulting with customers, Sales, and Marketing

1.3 MANUFACTURING, DISTRIBUTION, AND CONTROL GROUP
Manager: Steve Gutz (ML5-2/E50, 223-2239)

The Manufacturing, Distribution, and Control (MDC) product group develops products based on PDP-11s and VAXs for use in the manufacture and distribution of tangible products. Systems are sold to customers in the Fortune 500 (International 1000) engaged in either discrete (transportation, electrical, electronics) or continuous (chemicals) manufacturing.

The engineering group does its own hardware, system software, diagnostics, and technical documentation to develop MDC-unique products. The current products include a family of local area network products (the DECdataway), intelligent subsystems, and a line of I/O modules for use in the industrial environment.

2 COMPUTER PRODUCTS GROUP

2.1 GRAPHIC ARTS PRODUCT LINE

Manager: Steve Gross (MK1-1/D11, 264-6118)

The Graphic Arts Product Line engineering group designs computer systems products with applications in the printing, publishing, radio, and television and cable television industries. The products span the spectrum from the small LSI-based "knowledge worker" terminals to the large, 11/70 and 11/780-based multi-terminal systems.

Contact Graphic Arts engineering for market-focused or design consultation in their areas. Their experience gained with multi-processor networks, computing and intelligent terminals, and interfacing to non-Digital processing equipment is available. Specifications, schedules, and budget information will help them to help you.

2.2 TRADITIONAL PRODUCTS LINE

Manager: Don Freniere (NM, 264-7936)

This product line provides continuing engineering support to the customer who is using older systems and add-on hardware. The group also provides an outlet for excess equipment and small volumes of larger systems to support ongoing needs in certain segments of the marketplace.

The group assumes product responsibility for most CPUs no longer actively marketed and manufactured. The group sells refurbished equipment, PDP-11/35, 40, 45, 55, 60, XVM Systems, and PDP-15 Graphics. Its older traditional products include PDP-8, 8I, 8S, 8L, PDP-11/15, PDP-11/20, PDP-12, Industrial 14, PDP-16, and other 18-bit processors (PDP-10, DECsystem-10 and DECSYSTEM 20 traditional products are handled by the Engineering Systems Group, Section 3.4 of this chapter).

All of the group's factory-refurbished equipment is electronically and cosmetically perfect, updated to the latest ECO (engineering change order) levels, and all of the equipment is subjected to the same rigorous testing as Digital's new equipment.

Employees may purchase equipment from the Traditional Products group for personal use. Contact them for more information.

2.3 TERMINALS PRODUCT LINE

Manager: Barry James Folsom (MR2-1/M64, 231-6629)

This group sells terminals and related products. The primary function of the group is to be a major supplier of high-volume terminals to the business segments of the worldwide information market.

The group markets teleprinters (LA34, LA120), video terminals (VT100, VT132, VT101, VT131) and intelligent terminals (PDT11/150) to large volume purchasers. They also sell several specialized versions of these products. These products are aimed at meeting customer needs in an endless variety of data, communications, and information exchange applications. Typical applications include time-sharing, data capture, inquiry and response, transaction processing, telecommunications, and personal business terminals.

2.4 MICROCOMPUTER GROUP

Manager: Jim King (MR2-1/M64, 231-6632)

The primary funtion of this group is to market unbundled LSI-11 systems at the board level to customers who will purchase a required minimum volume. The group serves three classes of customers: high-volume users, low-volume users, and the home hobbyist.

The group sells the LSI-11 and its options, giving users the flexibility to buy the absolutely minimal system and expand it to meet the requirements of the application. They also market tools for hardware and software development, such as the PDP-11V03 and PDP-11T03 development systems and evaluation kits. General purpose interfaces, clocks, analog-to-digital and digital-to-analog converters, and communication options are available for the LSI-11/PDP-11/03. Operating system software, including RT-11 and RSX-11S with languages, is also available.

These products have been designed to supply users with reliable, low-cost systems for industrial process control, inventory control, data formatting, preprocessing, and developmental systems. A home hobby distributor uses many versions of the LSI-11 to provide his or her customers with kits. A photographic laboratory uses a version of the LSI-11 to obtain color separation balance when processing color films. A manufacturer of sheet plastic uses LSI-11s to control the thickness and mix of materials in the manufacture of the product.

2.5 WORD PROCESSING PRODUCT GROUP

Manager: Buzz Brooks (MK1-1/J14, 264-5500)

The Word Processing Product group focuses on two product areas. The first is the DECMATE line of stand-alone word processors, available with vertical applications through dealers and Digital computer stores. The other is the shared-resource word processing line built around the WS200, a PDP-8-based multi-terminal computer, and DECWORD, a PDP-11-based system using RSTS operating system software.

3 TECHNICAL PRODUCTS GROUP

3.1 LARGE COMPUTER GROUP

Manager: Rose Ann Giordano (MR1-1/KL5, 231-4049)

The Large Computer group (LCG) provides DECsystem-10s and DECSYSTEM 20s for a broad range of applications. These include the banking and insurance industries, manufacturing, educational institutions, timesharing, and governmental and private research and development.

Large Systems products are designed for use in a dynamic computing environment, characterized by a large number of users, large data bases, high level languages, and a high throughput requirement. These products function either in a stand-alone mode or as a "host" in a distributed network.

The following are types of processing supported by the DECsystem-10 and DECSYSTEM 20 families of Large Computer products:

- interactive
- concurrent multi-stream
- transaction
- real-time

3.2 TECHNICAL OEM GROUP
Manager: Ward Mackenzie (PK3-1/A60, 223-2884)

The OEM (original equipment manufacturer) buys Digital's products, adds substantial value, and re-sells or leases the products to a third party who is a separate corporate entity. If the end application of a computer is to be the management or control of a process or product, the OEM is defined as technical.

Applications for Technical OEM products include engineering and scientific (such as simulation, computer-aided design), instrumentation (instrument control and processing of instrument readings), medical (patient monitoring equipment, CAT scanners), industrial, government and telecommunications, and computer system products where Digital's product controls the OEM's product, such as the Xerox page printer and COM (Computer Output Microfilm) equipment.

The value of OEMs may be found in the several contributions which they offer. They multiply the effectiveness of the sales force. They are a stimulus to high-volume manufacturing, resulting in lower product prices for everyone. They provide greater product exposure to first-time computer users who later may buy Digital's end-user products. Technical OEM sales account for approximately 20% of all corporate sales.

3.3 EDUCATION COMPUTER SYSTEMS
Manager: Charles Rose (MR1-1/M40, 231-4360)

This product line group is a leading supplier of educational computing equipment, offering a range of products from small to large multi-user systems. They market standard PDP-11 and VAX-11 products worldwide, providing minicomputer systems, related software and support materials for instructional applications in educational institutions, government, and industry. They also provide computer systems to assist in the financial and operational administration of educational institutions.

In terminals, this group is responsible for the GIGI (VK100) intelligent keyboard, and for the complementary application software under RSTS/E, VMS, and TOPS-20. They have a strong focus on general imaging functions (for example, graphics) for the education environment.

Education Computer Systems designs and sells application software such as VAX-11, PASCAL, WISE, and DECAL, and a series of packages that support the GIGI terminal.

3.4 ENGINEERING SYSTEMS GROUP
Manager: Peter Smith (MR1-1/M42, 231-5160)

This group provides VAX-11/780s, VAX-11/750s, PDP-11s, and associated graphics and peripheral devices with computer-aided design applications to industry segments and engineering disciplines.

For industry, these products have applications in manufacturing, government, utility engineering departments, architectural and consulting engineering companies, design and build companies, and construction companies.

For engineering disciplines, these products have structural, civil, electrical, and electronic engineering applications.

3.5 GOVERNMENT SYSTEMS GROUP

Manager: Dana Lajoie (HZ, 264-7973)

This group sells all of Digital's products to governments outside the US, and to the US Government in Command, Control, Communications, Weapons Systems, Intelligence, and general Automated Data Processing (ADP) areas. They sell to prime contractors in the Command, Control, Communications, Intelligence, and Weapons Systems (C^3IWS) business.

Government Systems Engineering services the needs of these market segments and provides both hardware and software products. The group has specialized expertise in TEMPEST product engineering and other specialized government requirements.

Hardware:	Chuck Cobb (HZ, 264-7978)
Software:	Hobart Mendenhall (HZ, 264-8914)
Product Management:	Suresh Masand (HZ, 264-4878)

3.6 LABORATORY DATA PRODUCTS GROUP

Manager: Bert Bruce (MR2-4/E33, 231-4701)

This group provides computer systems, related software, and applications packages for research and scientific applications in educational and non-profit institutions, medical research, medical industry, and government institutions. Products include MINC and real-time front ends.

The group seeks to address the following scientific and research applications:

- Real-time and off-line acquisition of scientific and research data
- Graphic display of this data
- Multifunction (real-time, batch, timesharing) manipulation and management of scientific and research data
- Control of and data acquisition from scientific instruments and experiments
- Development of programs for acquisition, manipulation, simulation, and display of scientific and research data

The group's hardware and software development area can supply you with functional priorities, specifications, trade-offs, interconnection to other hardware, etc. The group can also tell you more about their applications, market size, and customers.

To assist you, Laboratory Data Products needs a general product description with a statement of the impact of the new product on internal products. They also need developmental costs, a realistic schedule, a first-customer-ship date, and volume schedule. They would also appreciate major specifications, with an analysis of the competition.

3.7 MEDICAL SYSTEMS GROUP

Manager: Wendy Mela (HU/E24, 225-4240)

The Medical Systems Group sells computer systems, related software, and supportive materials to the health care services industry and for occupational health care applications.

Specific areas of group expertise and accomplishment include development of the DSM-11 (Digital Standard MUMPS programming language) systems, and the related VAX-11 DSM layered language product. In the areas of medical image processing and real-time data acquisition, the Medical Systems Group has developed GAMMA-11, an RT-11-based system for nuclear medicine. They have also done work with distributed data processing, large multi-processor networks, and data management systems.

Medical Systems provides hardware and software products in these areas. Contact them for further information.

CHAPTER 9

MANUFACTURING

1 SYSTEMS MANUFACTURING

Manager: Bill Hanson (ML1-4/R14, 223-2238)

Systems Manufacturing has three major areas of responsibility. They are the manufacturing link to the Product Line groups, responsible for the US, Europe, and the General International Area (GIA). They are also Manufacturing's link to Systems Engineering. Systems Manufacturing aims to meet Corporate revenue shipment budget, while ensuring customer satisfaction by shipping quality systems products.

The following are some of the major groups within Systems Manufacturing.

1.1 COMPUTER SYSTEMS MANUFACTURING

Manager: Dave Thorpe (ML1-4/P11, 223-3222)

Computer Systems Manufacturing manages the manufacture of all Digital's computer-based systems. They aim to improve quality, reliability, asset utilization, customer service, and cost effectiveness.

Their links to Central Engineering are especially important to their success. 16-, 32-, and 36-bit Program Strategy Managers work with their counterparts in Engineering on project and program strategy and development. System Program Managers develop and implement strategies with Engineering Managers on specific systems products. On all new products, Manufacturing and Engineering are linked in this way down to the subassembly level. Working with Engineering and other organizations, Computer Systems Manufacturing is involved with products from conception and development to phase-out.

1.2 GIA (General International Area) MANUFACTURING

Manager: Dick Bradley (ML1-4/P14, 223-3143)

GIA Manufacturing provides manufacturing support for *all* of Manufacturing, by providing focus on manufacturing issues such as delivery, performance, quality, and customer satisfaction in the GIA area. The group also provides resources to jointly develop facility strategies for the international area in support of sales and manufacturing.

1.3 TECHNICAL PRODUCTS MANUFACTURING
Manager: Joe Cosgrove (ML1-4/P14, 223-3564)

Technical Products Manufacturing is Manufacturing's interface to the Technical Products product line group. (See Chapter 8, Section 3 for a description of the Technical Products product line group.) Each of the product groups within Technical Products has a Product Group Manufacturing Manager who works closely with a Product Group Manager.

Technical Products Manufacturing's responsibilities include running the Order Scheduling process and the Request/Commit system for expressing material requirements to manufacturing groups. They aid product groups in meeting their goals for Net Operating Revenue (NOR), inventory, and profit margins, and take part in the space, personnel, and production planning process.

1.4 COMMERCIAL AND COMPUTER PRODUCTS GROUP MANUFACTURING
Manager: Lou Gaviglia (NI, 261-2000)

Commercial and Computer Products Group Manufacturing manages manufacturing processes for the Commercial and Computer Products groups. Areas of support are the same as those of the Technical group, with a Product Group Manufacturing Manager assisting each product line. In addition, they manage the Systems Manufacturing distribution network.

1.5 EUROPEAN MANUFACTURING
Manager: Paul Neuman (Geneva, Switzerland: GE, [41]-(22)-933311)

European Manufacturing is divided into Volume Manufacturing and Systems Manufacturing. Volume Manufacturing, managed by Frank McCabe in Galway, Ireland, produces CPUs, memories, power supplies, and mid-range disk products for European markets. Systems Manufacturing supports the Technical and Commercial groups' European markets. In 1981, European manufacturing plants will ship approximately 40% of Digital's total European sales requirements.

1.6 TECHNOLOGY MANAGEMENT
Manager: Dennis O'Connor (ML1-4/P14, 223-4768)

Technology Management integrates product and process technologies developed by Engineering into long-range manufacturing business strategies. They drive new business plans and educate operational management. They also work with universities to aid in the transfer of future technologies for Systems Manufacturing.

1.7 MANAGEMENT INFORMATION SERVICES (MIS) MANAGEMENT
Manager: Pete Zotto (ML1-4/P14, 223-8497)

This group directs the development of Information Services strategies to support Systems Manufacturing's goals for customer services, quality, and cost. They link other manufacturing groups to the Digital Information Services organization.

2 GENERAL MANUFACTURING

Manager: Don Hunt (ML1-4/B21, 223-2859)

General Manufacturing manages four independent businesses:

- Field Service support
- High-technology/high-volume printed wiring boards
- Low volume communications and special application options
- Multifaceted engineering and manufacturing parts and service support

These are cross-group activities and products that do not readily lend themselves to vertical integration. Products approaching the end of their life cycle transfer into General Manufacturing for management of their manufacturing and spares needs. General Manufacturing also supplies unique low-volume products for special systems, and engineering prototypes calling for metal or printed wiring board fabrication, assembly, and test.

General Manufacturing's products include "C" class options, loose piece, module repair, mechanical fabrication, components, modules, printed wiring boards, power supplies, cables, and option repairs. Their customers include the volume product plants, Systems Manufacturing, Field Service Logistics, Engineering Services, and the product lines.

These are General Manufacturing's primary facilities:

Location and Manager	*Products and Processes*
Augusta, Maine Mike Eaton (AS, 271-2240)	Modems, Commercial Group products, options, modules, power supplies, and cable assembly and test
Maynard, Massachusetts Pete Koch (ML5-4/F32, 223-2632)	Modules, power supplies, cable assembly and test, printed wiring board and metal fabrication
Greenville, South Carolina John Caulfield(GS, 354-2212)	Printed wiring board processes: fine line, multilayer, high density, new technologies
Westford, Massachusetts Bob Roche (WJ2, 257-1220)	Field Service manufacturing
Nijmegen, Netherlands Bill Sergeant (JG, [31]-(80)-567000)	European Field Service manufacturing
Woburn, Massachusetts and Salem, New Hampshire Tom MacDonald (ZW, 284-3048)	Module, option, motor, and other repair and test; module, cable, and option assembly; Techmate and Diana Diagnostic Testers, suitcase testers

These functional managers can help you interface to General Manufacturing:

John Harrington, Manufacturing Engineering and Quality Control Manager (ML1-4/B21, 223- 9452)
Bel Cross, Long-Range Planning Manager (ML1-4/B21, 223-9090)
Paul Mantos, Materials Manager (ML1-4/B21, 223-3375)
Rufus Sanders, Manufacturing Information Systems Manager (ML1-4/B21, 223-9453)

3 TERMINALS MANUFACTURING

Manager: Dick Esten (ML1-5/B95, 223-3955)

The Terminals Manufacturing group manufactures and procures these general categories of products: printers, printing terminals, video terminals, microprocessors, and small systems.

Terminals Manufacturing's interface with Engineering is principally in the area of new products, especially in the early stages of planning and information coordination. The plants deal directly with Engineering on the development and support of product manufacturing. Key contacts:

Fred Forsyth, New Product Planning (LJ/D1, 282-2076)
Fred Oldfield, Manufacturing Process Engineering (ML5-1/E31, 223-2235)

They have four plants, a Functional Staff and Service group, an Acquisition Center, and strong ties to the Far East Manufacturing group (see Section 6 of this chapter).

These are Terminals Manufacturing's primary facilities:

Location and Manager	*Products and Functions*
Albuquerque, New Mexico Norm Kalat, Manager Bill Woodard, Planning Manager (AB, 552-2211)	Manufacturing: video terminals, microprocessors
Boston, Massachusetts Ralph Gillespie, Plant Manager Terry Wyszkowski, Planning Manager (BO, 281-2211)	Manufacturing: video terminals
Phoenix, Arizona Barry Cioffi, Plant Manager Herb Erbe, Planning Manager (PN, 551-2211)	Manufacturing: printing terminals, circuit boards
Westfield, Massachusetts Paul McGaunn, Plant Manager Mike Knowles, Planning Manager (WF, 242-2211)	Manufacturing: special video terminals, small systems, printing terminals
Phoenix, Arizona Jack Delbrocco, Materials Acquisition Manager (AA, 602-869-5610)	Acquisition Center: circuit boards, components

Location and Manager	*Products and Functions*
Far East Interface Ed McDonough, Manager (MO, 231-5419) Charlie Polay, Planning Manager (MO, 231-5421)	Manufacturing and purchasing: various products and components

These functional managers can help you interface to Terminals Manufacturing:

Dick Esten, Group Manager (ML1-5/B95, 223-3955)
Dawn Greeley, Planning Manager (ML1-5/B95, 223-7374)
Bob Hopley, Materials Manager (HY, 259-3793)
Lou DiFinizio, Quality Manager (HY, 259-3760)
Fred Forsyth, New Products and Manufacturing Engineering Manager (LJ/D1, 282-2076)
Chad Cutler, Manufacturing Information Systems Manager (HY, 529-3761)
Chris McGill, Marketing Interface Manager (ML1-5/B95, 223-9177)
George Wood, Project Manager (ML1-5/B95, 223-7371)

4 STORAGE SYSTEMS MANUFACTURING

Manager: Bob Puffer (ML1-5/B94, 223-2863)

Storage Systems Manufacturing manufactures the disk, tape, and floppy disk storage products designed by Storage Systems Development. (Storage Systems Development's groups are outlined in Chapter 5, Section 5.) In partnership with Storage Systems Development, they manage Digital's overall storage business strategy.

Storage products are manufactured at these plants:

Location and Manager	*Products and Processes*
Colorado Springs, Colorado Bob Browne (CX, 522-3351)	Disk drives, controllers, cartridges
Natick, Massachusetts Michael Flaherty (NA, 233-2110)	Magnetic disk and tape heads
Springfield, Massachusetts Ron Payne (SP, 243-2240)	Floppy disks, tapes, tape cartridge drives, controllers
Tempe, Arizona Charlotte Frederick (TF, 302-894-5600)	Printed wiring boards

The Western plants, Colorado Springs and Tempe, interface with the Development organization in Colorado Springs. The Massachusetts plants interface with the Maynard Storage Development Groups.

These managers can help you interface to Storage Systems Manufacturing:

Bob Puffer, Vice President and Group Manager (ML1-5/B94, 223-2863)
Ed Barron, Technology Manager (ML1-5/B94, 223-9826)
Bob Jack, Manufacturing/Engineering and New Products Manager (ML1-5/B94, 223-6615)
Pat White, Quality Manager (ML1-5/E30, 223-7557)
Greg Plakias, Manufacturing Manager (Eastern) (ML1-5/T33, 223-9723)
Steve Stolle, Information Systems Manager (ML1-5/B94, 223-9579)
Bill Lowe, Materials Planning and Purchasing Manager (ML1-5/B94, 223-9733)

5 LSI MANUFACTURING

Manager, Jim Cudmore (ML1-5/E30, 223-2393)

LSI Manufacturing is part of the LSI Engineering and Manufacturing group. See Chapter 5, Section 4, for a description of the LSI Engineering organization. The LSI Manufacturing organization includes the 1100-person Hudson Manufacturing plant (HL) and the 700-person Aquisition and Test (A&T) organization.

The Hudson Manufacturing plant, located in Hudson, Massachusetts, houses the Manufacturing and the Semiconductor Engineering group. Their specialized facilities include two wafer fabrication operations, one for metal oxide semiconductors (MOS) and one for bipolar custom LSI. The plant also does pilot assembly and test on in-process wafers and on finished integrated circuits. Pilot assembly in Hudson is supported by a production assembly operation in Digital's Taiwan plant. In addition to normal plant support operations, Hudson also maintains extensive quality, reliability, and product engineering efforts.

Hudson's primary function is to support the production, assembly, and test of the custom integrated circuits designed for Digital's sole use. They provide quick turn-around prototype production during the design debugging of new circuits, and act as a first or second source after release to production. Hudson's primary engineering interaction is with Semiconductor Engineering, as they, in turn, support other engineering groups within Digital.

The 700-person Acquisition and Test (A&T) organization was the sole interface between Digital and the semiconductor industry for the purchase, test, and distribution of all of Digital's LSI and memory requirements. This role is changing as Digital moves to vertically integrate each manufacturing group. The purchase, test, and distribution of mature integrated circuits (those whose specifications, test processes, and yield are stable) is being moved into test centers such as San German, Puerto Rico, Phoenix, Arizona, and Galway, Ireland, to be closer to the site of use and under control of the user. In the long run, A&T will continue to be solely responsible for vendor base management; in the short run, they continue in a substantial production support role. Engineering groups interact often with A&T as they require new integrated circuits. A&T identifies and contracts with suppliers for new circuits. They qualify, establish test specifications, provide specification documentation, and ensure the quality of these new parts. Their substantial purchasing and component engineering resources support engineering requirements in this area.

6 FAR EAST MANUFACTURING ENGINEERING

Manager: Frank Cassidy (MO, 231-5317)

The Far East Manufacturing group does high-volume, low-cost manufacturing. Its several plants are an important part of Digital's manufacturing operation, producing $175 million of products in fiscal 1981. Their current products include memories, power supplies, communication modules, video terminals, power controllers, mass storage controller modules, and others.

Far East Manufacturing Engineering is divided into Memory, Process, and Product Manufacturing Engineering.

All memory manufacturing processs in Digital are the responsibility of the *Memory* Manufacturing Engineering group. Managed by Tom Marmen (MO, 231-5364), this group develops, defines, and maintains memory manufacturing processes, and introduces new memory products. They study the testability of new products, and select, design, and manufacture memory test equipment.

Process Engineering, managed by Steve Cullen (MO, 231-4512), develops test packages, mechanical fabrication processes, and provides process management. They also provide producibility services for Far East printed circuit products. The Producibility group, managed by Dick Dunlop (MO, 231-5543), develops a strategy for corporate standardization of module design rules (as described in DEC STD 030, *Module Manufacturing Standard*). The goals are cost competitiveness, optimum asset utilization, and meeting aggressive productivity goals.

Product Manufacturing Engineering, managed by Ed Doyle (MO, 231-5363), introduces new products into Far East plants. Products are either transferred from a domestic plant or begun as new products.

For products to be manufactured in the Far East, staff engineers must review:

documentation	test strategy, process, and procedures
producibility	packaging
tooling	component sourcing
training plan	

They assist with the development of the Manufacturing Plan and the PMT (Process Maturity Test) Plan. They are also the engineering communication channel for information flow between product users and the Far East plants.

CHAPTER 10

INFORMATION SERVICES

1 DIGITAL LIBRARY NETWORK

There are several library information centers located throughout Digital. The largest is Corporate Technical Information and Systems Library Services (CILS), an information center located in Maynard. It works cooperatively with 11 information centers in the Digital Library Network. Most information centers have information resources covering:

- On-line data bases in engineering, applied science, management, pure science, and other areas
- Books, especially engineering, management, and technology
- Directories, dictionaries, encyclopedias, handbooks, phone books
- Technical reports in engineering and management
- Periodicals
- Indexes and abstracts of periodical and report literature
- Standards
- Audio and video cassettes
- Competitors' manuals and promotional material
- Digital manuals, handbooks, bulletins
- Reference research consultants to assist you with specific engineering, technical, and business questions.

Contact the library information center at your location for assistance with engineering, technical, and business questions.

Digital Library Network

Location		*DTN*	*Personnel and Mailstop*
Colorado Springs		522-3116	Chris Blake, CX
Hudson		225-4771	Joyce Ward, Joan Allard, HL
Marlboro		231-5040	Michelle Johnson, MR1-2/A94
Maynard Corporate		223-6231	Borrowing materials
Information and		223-5038	Reference research consultants
Library Services			ML4-3/A20
Merrimack		264-5482	Nancy James, Sharon Penasack,
	or	264-6186	Michelle Rodriques, MK1-2/F5
Nashua		264-8036	Charlie Matthews, Dottie Mamos
	or	264-8050	ZK1-3/B31
New York City		333-3350	Frank Mauriac, NY
Rolling Meadows		421-5712	Janean H. Bowersmith, RL
Salem		261-2254	Nancy Sullivan, NI/W22
Santa Clara		521-2283	Lindalee Cummings, WR
Tewksbury		247-2643	Janet Slinn, Janet Potter, TW/B01
	or	247-2423	
Westminster		241-2537	Susan Kelly, WM/A74

Information Services
Each library information center's reference research staff provides professional consulting on employees' questions on a wide variety of topics. The reference research staff uses thousands of published sources and over 150 on-line data bases to obtain timely, critical information to help you with key decisions.

SCAN, SCAN/UPDATE
SCAN is the name for computer-aided reference information services. Usually, the product is an annotated bibliography of abstracts from externally published information sources, which can be ordered in full text from your library information center. If you need to identify what has been written on a specific job-related topic, over 150 data bases of engineering, technical, and management publications and research are covered.

SCAN/UPDATE is a service that can provide you with a monthly update of information sources on your topic. Every Digital employee who has a job-related need can benefit from this service. Trained information specialists will interview you to determine your needs. To use either SCAN service, call your local library information center for a SCAN request form.

Books, Technical Reports, The Library Catalog, and Interlibrary Loan
Books selected for the Digital Library Network contain new and important material in your areas of interest. Recommendations for acquisition are always welcome.

Books are arranged by the Library of Congress alphanumeric classification call number, which also appears on the spine of the book. A COM or printout catalog has replaced the traditional card catalog at many locations. Books are listed in the catalog by author, title, and subject. Audio-visual media are listed as well. In addition to books and technical reports in the Digital Library Network, each library information center has access to 7.5 million volumes in a national on-line network of university and special libraries.

Circulation of Materials
Any Digital employee may borrow material from the Digital Library Network by visiting, sending a request, or telephoning the nearest local library information center, subject to individual library policies.

Books, reports, and audio cassettes are loaned for four weeks, subject to recall after two weeks if requested by another borrower. Periodicals are loaned for two weeks. Video materials and manuals are loaned as needed. If a book, report, or instructional course is on loan, you can request to have your name put on a waiting list or ask if another copy is available in the network. As soon as the item is available, it will be sent to you.

Periodicals (Journals, Newspapers, Newsletters, and Bulletins)
The Digital Library Network subscribes to over 1000 periodicals to benefit employees in their fields of endeavor. Although holdings include microfiche and microfilm, photocopies of any article will be provided on request. Back issues may be borrowed. Photocopies of articles may be requested. Many libraries distribute semiannual lists of their periodicals and indexes.

Audio-Visual Media
Several hundred audio and video cassettes are available in the Digital Library Network. A list is available as part of the Automated Digital Library catalog.

Digital Publications
Each library information center has a reference collection of Digital publications. Hardware manuals, software manuals, handbooks, special publications, and directories are available for use in the library. In addition, local and specialized Digital newsletters and bulletins are available.

Competitors' Publications
Digital exchanges publicly-available information–promotional material, software and hardware manuals–with ten other computer manufacturers. The Corporate Information and Library Services, Maynard, maintains a complete collections of these documents. The competitors' indexes of publications and a list of holdings are available on fiche from Corporate and other library information centers. Copies of each document can be loaned throughout the network.

Purchasing Activities
Corporate Information and Library Services processes internal requistions for books, subscriptions, reports, standards, and association memberships for the BG (St. Bridget's), CF (West Concord), ML (Mill), MS (Powdermill Road), and PK (Parker Street) locations as well as WJ (Westford), and other new sites that do not have a purchasing function. All items must be submitted to CILS Purchasing, HL2-3/A20, on a Digital Internal Purchase Requistion, Form Number EN-1072A-08. If your location is not listed above, check with the purchasing group at your site.

Subscriptions must be authorized by a Vice President or a person designated by a Vice President. It is Digital's corporate policy to purchase only one membership to an organization per cost center. Individual memberships in IEEE and other general professional societies are not paid for by Digital.

Automated Library Systems
In addition to the standard information and technical services, the CILS Operations staff is initiating the beginning phases of an integrated automated library system. This specialized data base manage-

ment system is intended to provide on-line access to cataloging data for books, journals, and Digital-published material. Participating library information centers will be able to identify, locate, and borrow on-line any materials in the Digital Library Network.

Other Information Services
The Digital Library Network is not the only place you can go for information. Another is the Software Standards library. This library maintains a file of ISO, ANSI, FIPS, ECMA, CCITT, and Corporate Standards. Standards and Methods Control can supply you with hard and microfiche copies of Digital Standards. The Market Data Center is a source of marketing and competitive information. The VSMF (Visual Search Microfilm File), maintained by Specification Control Systems, contains manufacturing information, vendor information, industry manuals, specifications, and standards, and military and federal specifications and standards. Some of these libraries are described in detail elsewhere in the manual (see the Index).

2 DATA CENTER SERVICES

Manager: Bart Mecum (PK1/E33, 223-5188)

Data Center Services (DCS) is a part of Information Operations and Services. They provide a variety of information operational services for groups that do not have their own data center, or that are just establishing their own center.

2.1 CORPORATE DATA CENTER

Manager: Norman Shakespeare (PK1/E33, 223-4247)

The Corporate Data Center provides computer access and support services. They employ DECsystem-10, DECSYSTEM 20, and PDP-11/70. VAX/VMS will be available in late 1981. Standard Digital software is used. Their groups include Computer Operations (223-7864), Production Control (223-7872), and Customer Assistance (223-5715).

The Corporate Data Center also helps groups to start up their own data centers.

2.2 DATA CENTER CENTRAL SERVICES

Manager: Wally Majewski (PK1/E33, 223-2314)

Data Center Central Services (DCS) comprises several groups:

The *COM* (Computer-output microfiche) group (223-4794) provides reproductive services such as microfiche and microfilm production, diazo duplication, silver duplication, film processing, and source document filming.

Distribution (223-7881) provides distribution for COM products.

The *Tape Library* (223-8941) stores user tape inputs.

Xerox (223-7643) provides the services of a Xerox 9700: high-speed laser imaging printing, printing multiple impressions per page, printing using different character sets and fonts.

2.3 DATA CENTER PLANNING

Manager: Tom McLellan (PK1/E33, 223-4755)

Data Center Planning forecasts the hardware, capacity and contingency needs of Data Center Services. They also provide EDP (electronic data processing) security for the PK1 facility.

2.4 INTEGRATION AND TECHNICAL SUPPORT

Manager: Joe Johnston (PK1/E33, 223-4675)

Integration and Technical Support provides data communications and network planning for Information Operations and Services, new product and service evaluation, and data communications consulting.

3 MARKET DATA CENTER

Manager: Pamela Gifford Hallaren (PK3-1/S52, 223-2504)

The Market Data Center provides a central source of marketing and competitive information that can be used by all product lines and groups, Sales, Planning, Marketing, Engineering, and functional group personnel. Two primary areas make up the Market Data Center: the Market Data Research Center, and the Customer History Data Base.

3.1 MARKET DATA RESEARCH CENTER

Manager: Pamela Gifford Hallaren (PK3-1/S52, 223-2504)

The Research Center collects and organizes marketing-related information, answers reference inquiries, aids in research for specific projects, lends reports to requesters, and distributes the monthly Market Data Center Memo, a review of newly acquired reports. They maintain a collection of market research reports, directories, competitive files, and various marketing statistics and publications. Most notable are the following:

- *Market Research Reports*: The current collection consists of over 700 reports with subjects that range from in-depth analyses of specific products to broad overviews of certain industries. Information programs subscribed to include the following:

    - Stanford Research Institute's Business Intelligence Program
    - International Data Corporation's Corporate Planning Service
    - Quantum Science's MAPTEK Program
    - INPUT's planning services
    - DATAQUEST's planning services

    These services supply marketing reports of all types on a regular basis.

- *Competitive Information*: Information about our competitors is available from many sources, including:

    - *Competitive Company Files*: Press releases, product brochures, financial statements, news clippings
    - *Competitive Product Inf*ormation: Datapro & Auerbach series, competitors' reference manuals

- *Reference Manuals*
- *Annual Reports*: Competitors and Fortune 500 Companies
- *Consulting Organizations/Data Sources*: Organizations involved with marketing research
- *International File*: Market-sizing information on the non-US marketplace
- *Reference Books*: Dun and Bradstreet Directories, Thomas' Register, Moody's, Standard and Poors, State Industrial Directories, Who Owns Whom Directories, Industry Surveys, Industrial Outlook
- *Periodicals*: Harvard Business Review, Journal of Marketing Research, Sales Management, Fortune, Duns, Forbes, Datamation, Computerworld, Electronic News
- *Industry Newsletters*: Electronic Data Processing (EDP) Industry Reports, Autotransaction Industry Report, EFTS Industry Reports, Small Business Computer News, Micrographics Newsletter, Packaged Software Reports

3.2 CUSTOMER HISTORY DATA BASE

Manager: Toni Demars (PK3-1/S52, 223-3690)

This is a computerized data base of Digital's US customers, showing bookings by product line back through the fiscal year of 1972 and revenue by product line back through the fiscal year of 1979. At present, there are only a limited number of scheduled output reports, all quarterly. There are volume analysis reports for the US area, US regions, national accounts, major accounts, and Product Lines. All other requests are handled on an individual basis. Normal turnaround is two to three business days.

CHAPTER 11

CUSTOMER SERVICES

Manager: Jack Shields (PK3-2/A58, 223-2548)

The Customer Services group is made up of six major organizations that are crucial to the continued development of Digital's business: Customer Service Systems Engineering, Accessories and Supplies Product Group, Computer Special Systems Product Group, Educational Services, Field Service, and Software Services. These organizations are described in the paragraphs below.

1 CUSTOMER SERVICE SYSTEMS ENGINEERING

Manager: Steve Davis (PK3-2/S17, 223-2361)

Customer Service Systems Engineering (CSSE) provides technical expertise on customer service issues to Digital's development community during the planning and introduction of new products. They develop service products, Reliability and Maintainability (RAMP) definitions, Customer Service and market needs. CSSE helps to ensure that Digital's products are of high quality, cost-effective, and safe to use.

CSSE provides quantitative consulting services to clients within Customer Services and from other parts of the corporation. They are responsible for the hardware and software engineering of Customer Services' tools.

The three organizations within CSSE are Maintainability Engineering, Customer Service Engineering, and Management Science.

1.1 MAINTAINABILITY ENGINEERING

Managers: Henry Adleman (PK3-2/K41, 223-2638)
Joel Berman (TW/A02, 247-2520)
Walter Manter (MR1-1/S35, 231-6503)
Lee Mickle (WJ1, 257-1142)

Maintainability Engineering is the engineer's interface with Customer Services. They make sure that Digital's products can be serviced by our field organizations. They do this by working closely with the design engineer. They also lead Customer Services' new products introduction team, coordinating efforts to ensure that the tools are available to service a new product, and that field introduction happens smoothly.

Contact Maintainability Engineering early in Phase 0, while product requirements are first being defined. Early consideration of service requirements is critical to the economical design of a product.

If you do not know whom to contact in Maintainability Engineering, call the manager listed below under the type of product you are designing. This person will assign a Maintainability Engineer to work on your project.

Small Systems Hardware:	Howard Janke (WJ1, 257-1127)
Terminals:	Angela Smith (WJ1, 257-1141)
Customer Services CT (Computing Terminal) Program Office:	Darrel Bates (ML5-2/T53, 223-2763)
Advanced VAX Maintainability:	Doug Hanzlik (TW/A02, 247-2525)
Current VAX Maintainability:	Hank Watkins (TW/C18, 247-2577)
Maynard Mass Storage:	John Florentine (PK3-2/H17, 223-2010)
Colorado Springs Mass Storage:	Don Ames (CX, 522-3139)
Commercial Systems Software:	Phyllis Dunn (MK1-1/H02, 264-5157)
Technical Systems Software:	Ken Biddle (ZK1-2/C7, 264-8507)
European (all software products developed in Europe):	Stuart MacKenzie (Reading, England, [07]-(34)-85-131)
Software Communication Products:	Carroll Wright (TW/E92, 247-2155)
Hardware Communication Products:	Mark Hald (MK1-2/C15, 264-5930)
Communications Systems:	Bill Lahtinen (TW/D11, 247-2057)
Large Systems Hardware:	Art O'Donnell (MR1-1/S35, 231-6405)
Large Systems Software:	Jack Walden (MR1-1/S35, 231-5125)
Product Line Engineering (Telco, Graphic Arts, Word Processing, Retail Products, COEM, CSS, CSI, TPL):	Norm Bernard (MK1-2/K13, 264-5935)
Product Line Engineering (LDP, IND, MDC, IND, MDC, ESG, TOEM, MSG, GSG, Terminals, Micros, ECS):	Ed Kenney (MR1-1/S35, 231-5175)

1.2 CUSTOMER SERVICE ENGINEERING
Manager: Chris Ball (PK3-2/S77, 223-3040)

Customer Service Engineering designs, develops, and releases to Manufacturing any products needed to support Customer Services. These include providing tools for Field Service, training delivery systems for Educational Services, and software support tools needed by Software Services.

1.2.1 Remote Diagnosis Engineering
Manager, Hardware Development: Ken Raina (PK3-2/H29, 223-6349)
Manager, Software Development: Ed Spuler (PK3-2/H29, 223-7511)

Remote Diagnosis Engineering develops the remote diagnosis maintenance tools for PDP-11, VAX, and the DECsystem-10 and DECSYSTEM 20 families of products for the entire world. The group provides support to existing and planned Digital Diagnostic Centers. This support takes the form of new host software development, host software enhancements, problem resolution, design of remote diagnosis hardware, and support to existing hardware designs (consoles). For existing hardware designs, support includes problem analysis, the incorporation of ECOs (Engineering Change Orders), modification of equipment for other countries, and approval by Postal Telegraph and Telephone authorities for hookups on their telephone lines.

The Remote Diagnosis Engineering group provides consultation to CPU and peripheral design groups to ensure a product's capability for remote diagnosis, or to determine if new opportunities are possible by remote diagnosis.

Contact the group, via the assigned Customer Service Maintainability Engineer during the concept phases of any central processor or intelligent subsystem that is to be remotely diagnosed. The group will provide the remote diagnosis plan that will include hardware to be connected to the unit under test, and the diagnostic script to be run in the host computer. You will be required to furnish the group with a set of maintainability goals and objectives for the product, and to specify the Remote Diagnosis port interface.

1.3 RELIABILTY AND MAINTAINABILITY PROGRAM (RAMP)
Manager: John Shebell (PK3-2/K30, 223-3101)

RAMP provides a wide variety of support services to Customer Services and to the product development community:

- Measurement and analysis of the availability, reliability, and maintainability of our products and systems
- Power systems, packaging, and environmental engineering support for CSSE and the Accessories and Supplies Group
- Basic technology support for Customer Services for components, physical interconnect, signal integrity, FCC compliance, and similar issues
- Operational support for the Corporate Pricing and Policies Committee and for Customer Services' role in the Phase Review Process
- Long-range technology planning for Customer Services
- Consulting on reliability and maintainability for technology and market areas

Normally, RAMP works through the Customer Services product development teams. Contact RAMP directly, however, for information and support relating to general service strategies and plans, field data analysis and metrics, and technology-intensive issues. RAMP considers itself "the people to call when you don't know whom to contact in Customer Services."

1.4 MANAGEMENT SCIENCES

Manager: Robert Levasseur (PK3-2/S53, 223-5960)

Management Sciences is an internal consulting organization primarily supporting Customer Services and Sales. It contains a consulting and a support systems group.

1.4.1 Management Science Consulting

Managers: Ed Vail (PK3-2/S53, 223-5736)
John Wetmiller (PK3-2/S53, 223-6337)

Management Science Consulting researches areas such as improvement of the engineering design process, branch office modeling, life cycle costing, repair strategies, and logistics. Group managers can help you determine if their work applies to your area.

1.4.2 Management Support Systems

Manager: Frank Polischuk (PK3-2/S53, 223-6053)

Management Support Systems provides Decision Support Systems for Management Science Consulting, Customer Services, and Sales. They develop decision models, and provide continuing support for large ones.

2 ACCESSORIES AND SUPPLIES PRODUCT GROUP

Manager: John Alexanderson (RQ/A30, 264-5160)

The Accessories and Supplies Group (A&SG) consists of two product lines: Computer Supplies and Customer Spares. They provide a complete line of supplies, maintenance, and expansion products and services to complement Digital's hardware products.

2.1 DIGITAL COMPUTER SUPPLIES

Manager: Bruce Rollinson (RQ/N50, 264-5768)

Computer Supplies offers a complete line of operating supplies, site accessories, software documentation and components, and communications options. They also distribute and support add-on products that expand the functions of hardware and software products. Organized to provide responsive service to Digital's worldwide customer base, Computer Supplies' distribution network supplies 48-hour turnaround time for 95% of its products. Contact the product managers listed below for more information about their products.

Group	*Manager*
Senior Product Manager	Steve Grinley (RQ/N50, 264-5799)
Magnetic Media Products	Tom Dixon (RQ/N50, 264-4536)
Ribbons, Paper, and Site Accessories	Bill Choquette (RQ/N50, 264-6786)
Software Documentation	Haywood Gandy (RQ/N50, 264-6805)
Terminals and Add-on Products	Dale Gagnon (RQ/N50, 264-5164)
Communications Devices (Modems)	Ric Allen (RQ/N50, 264-8846)

2.2 CUSTOMER SPARES

Manager: Ron Rando (RQ/E72, 264-6977)

Customer Spares offers a full spectrum of maintenance products and services to customers who elect to perform their own computer hardware maintenance or to expand and enhance their systems. Spare parts are available either singly or in engineer-designed spares kits. Other self-maintenance aids include tools and test equipment, preventive maintenance parts, Field Change Order information and parts, and hardware documentation and diagnostics. The hardware documentation is available by subscription on microfiche as part of the Maintenance Documentation Service.

Aids for customers in determining their inventory needs include the Maintenance Product Recommendation Service, which furnishes inventory recommendations based on a 70% to 98% level of service, and the Parts Availability Service, which provides up to ten years of spares support on a contractual basis. For more information about Customer Spares, contact the following product managers:

Technical Services: Verne Westgate (RQ/E72, 264-6981)
Product Manager: Arnold Beauregard (RQ/E72, 264-6980)

2.2.1 Environmental Products and System Accessories

Manager: Gerald Beauchesne (RQ/S61, 264-8721)

This Customer Spares group consists of the following:

Environmental Products (manager: Bill Coleman, RQ/S61, 264-4681) provides enhancements for the computer system environment. Products address the quality of electric power, improvements to raw power, and customer convenience in providing power to a computer system.

System Accessories (manager: Ron Souter, RQ/S61, 264-6807) provides system expansion products such as cables, cabinets, expansion boxes, backplanes, and connector blocks.

3 COMPUTER SPECIAL SYSTEMS PRODUCT GROUP

Manager: Jerry Butler (NP, 264-6209)

This group is devoted to filling customer needs not otherwise satisfied by Digital's standard volume offerings. In performing this function, Computer Special Systems (CSS) engages in two mutually complementary and supportive businesses. First, they design and develop special hardware, software, or turn-key systems for specific customer applications. Second, they design and develop a wide range of hardware and software products which are application-oriented or complement Digital's standard product offerings.

To achieve these ends, the group has its own Marketing, Engineering, and Manufacturing organizations for software as well as hardware. CSS is spread throughout the world: in addition to having three Engineering/Manufacturing facilities in the United States, CSS has facilities in Canada, Australia, Japan, the United Kingdom, France, Sweden, and Germany. Each facility has a marketing, engineering, and production staff, and is capable of designing and manufacturing products to special order.

CSS projects vary from very small to large and complex, and from essentially "standard" products to tailored one-time systems with special hardware and software.

4 FIELD SERVICE

Manager: Dick Poulsen (PK3-2/S87, 223-7429)

Field Service provides high-quality, accessible, cost-effective preventive and remedial maintenance services for Digital's customers. Field Service has segmented its business into three major groups (Terminals, Computers, and Systems) to focus on service-delivery methods most effective in each segment. The Field Service organization includes over 8,000 service representatives operating from a network of over 400 field locations.

Field Service works with Engineering through the Customer Service Systems Engineering (CSSE) organization (see Section 1 of this chapter). CSSE is the primary interface to Engineering within the Customer Services organization. They ensure that products are developed with reliability, availability, maintainability, and productivity (RAMP) features, to meet the service needs of customers at a low cost of ownership. (See Section 1.3 of Chapter 11 for more information on RAMP.)

5 EDUCATIONAL SERVICES

Manager: Del Lippert (BU/E17, 249-4200)

The primary purpose of Educational Services is to communicate information. The organization helps customers and employees make better use of Digital products by acquiring new skills and knowledge. They also provide computing education to the general public.

Over 1200 employees produce courses and instructional products. They also produce technical publications (in print and microfiche), and offer book and media services. Last year the organization operated 250 classrooms at 27 worldwide training centers, presenting over 300 different courses. They provided 500 computer systems for use in 2.5 million student hours of instruction. They also produced 35,000 color slides, 16.6 million microfiche sheets, and published over one million volumes of technical manuals.

Basically, Educational Services is a conduit for technical information. They gather, interpret, organize, and then disseminate information in the most effective and efficient medium.

The organization has tied their course development people and technical writers to Digital's seven Engineering sites across the US and Europe. Their goal is to make sure that courses and publications reflect state-of-the-art information via the latest media and methods. For example, the organization develops new audiovisual courses, uses modern instructional technology (such as video disks and computer-based instruction), and employs computer-generated graphics, visuals, and typesetting.

Using information from Engineering, Marketing, Software Services, and Product Support, the organization transforms this data into three basic products:

- *Instructional Services and Products*: lectures and lecture/lab demonstration, self-paced and computer-aided instruction

- *Technical Documentation*: technical manuals and microfiche, books published by Digital Press

- *Media*: corporate resource for artwork, video tapes, slides, photography, audio tapes, and educational writing and editing

Educational Services serves Digital's customers, Field Service, Software Services, personnel management, Digital Information Systems, and any other group that needs their services.

Contact Education Services on any of the following occasions:

- When you want to take a course
- When you are in the design stage of a product
- When you want to work with technical writers on documenting your new hardware product
- When you want to write a book for Digital Press
- When you need visuals, typography, editing, writing, or audiovisual support services for an upcoming paper or presentation

To enroll in a course at one of the training centers, or at an ILC (Individual Learning Center), contact Bedford (249-4674).

To obtain an Employee Catalogue and more information about courses available, contact Pat Cataldo, US Employee Education Manager (US, 617-568-1431).

For technical documentation and course development assistance, contact Joe Santini (BU/E02, 249-4387), or any of the site managers:

Maynard:	Carl Klempner (PK3-1/T12, 223-2487)
Merrimack:	John Griffin, acting (MK1-2/M26, 264-6600)
Tewksbury:	Judy Jurgens (TW/D04, 247-2621)
Marlboro:	Bob Hymes (MR1-2/T17, 231-5972)
Bedford:	Mike.Padovano (BU/E06, 249-4207)
Reading, England:	Jack Cromwell(RG, [44]-(734)-58-3555)

For Media Services, contact Marvin Rothberg (BU/E35, 249-4020).

For Digital Press, contact Marcia Kenah (BU/E44, 249-4072).

6 SOFTWARE SERVICES

Manager: Don Busiek (PK2/S56, 223-5199)

The primary goal of this organization is to satisfy the software services needs of Digital's customers. The organization ensures that software products and services are easy to sell, install, use, and maintain.

Software Services consists of Field Software Services, the Operations Group, and Corporate Adminstrative Systems.

Field Software Services: The field consists of three areas: the United States, Europe, and the General International Area (GIA). Field Software Services is responsible for providing four basic services to customers, through local offices throughout the world, and through centralized Telephone Support Centers.

- *Warranty Services* are described in the Software Support Categories Addendum to the Software Product Description. These services may include installation of supported Digital software products, answers to written or telephoned inquiries on remedial service and usage questions, and on-site visits when necessary.

- *Sales Support*: Software Services is part of Digital's sales team and as such is responsible for all technical aspects of the sale of software products.

- *Professional Services* offer a wide range of consulting and project management services to customers on a resident, time-and-materials charge, or fixed-price basis.

- *Software Product Services* support standard software products after software product warranties expire. Contractual Software Products Services include Self-Maintenance Service for Software, Basic Service for Software, and DECsupport Service for Software. Software Product Updates are also available.

The *Operations Group* provides centralized technical support to Software Services. They also coordinate training and administrative activities, and act as an intermediary between Field Software Services and other corporate groups. They develop and maintain internal Management Information Systems, and perform code maintenance for certain products.

The Operations Group includes the following groups:

- The *Technical Support Group*, managed by Dave Backman (PK2/S44, 223-7110), provides field technical services for Digital's software products. They interface with other groups involved in the creation and delivery of software products, including Software Engineering and Customer Service Systems Engineering. Support services include back-up support to Field Software Services, maintenance of Large Systems Group products, participation in the introduction of major products, creation of support tools, and assistance with teaching and training services.

- The *Management Information Services Group* (MISG), managed by Bill McCullough (PK2/S44, 223-4876), designs and develops internal programs to aid Software Services in managing and controlling its operations. They run these internal programs in a production environment.

The *Corporate Administrative Systems Group* (CASG), managed by Angela Cossette (PK2/E49, 223-4511), provides support services to Software Services and central services to customers. CASG interfaces with Engineering about functions such as Software Performance Report (SPR) administration, Software Product Descriptions (SPDs), field testing of software products, and publications such as Dispatches and Buffers.

Software Services needs for you to develop reliable, high quality software products to minimize support costs. Software products, ideally, should be easy to sell, install, use, and maintain.

The organization also asks your cooperation in providing prompt Software Performance Report SPR) replies to customers. They also need assistance in conducting effective field testing of new and revised software products. Furthermore, Software Services needs technical assistance in the support of software to meet their goal of having satisfied customers. They also need active participation by Software Product Management in the generation of Software Product Descriptions.

CHAPTER 12

REFERENCES AND RESOURCES

This section references information about Digital's publications, committees, and services. Listed is information that can help you obtain copies of promotional materials, hardware and training materials, software documentation, and financial information. Additionally, some company policies, standards, and specifications are described briefly. For your information, lists of company newsletters, library publications, and current committees are included. Finally, this section highlights resources available in the Digital Telephone Directory as well as what you should know about company transportation and employee training and education.

1 PUBLISHING AND CIRCULATION SERVICES

Manager: Dick Wesche (NR2-2A1, 234-4305)

Printing and Circulation Services (P&CS), a part of Digital Information Services, provides various related services to help you plan, produce, procure, and distribute your communication requirements.

Customer Services assists in coordinating your graphic communications (typesetting, printing and mailing) requirements. They make sure that your job is prepared and organized for production by P&CS or an outside vendor.

Address:	NR2-2/C2
Manager:	234-4403
Supervisor:	234-4220
Hotline:	234-4297

The *Customer Literature Inquiry Service* fills customer requests for promotional literature, where the inquiry is the result of a Digital advertisement, publicity, trade show, or other promotional activity. If you are contacted by someone outside the company looking for this type of literature, forward their requests to this operation.

Order Service: (inside Digital) 234-4401
(outside Digital) (617)393-4401

The *Publications/ Literature Order Processing/Fulfillment* group distributes the majority of Digital's promotional materials, technical documentation, and internal general-use printed forms. When a group needs to order this type of material, the cost center manager may contact a "lit (literature) contact" to coordinate requests. P&CS puts out Publications Indexes with lists of materials available from this operation.

To request materials, fill out a Request for Literature form (EN-01878-05), and mail it to NR2-2/W3. Urgent requests can be sent by RCS code (TWX) NR12, or by FAX 234-4257. Accurately indicate the part number of each piece ordered. Orders for literature and forms are normally shipped within 5 work days after receipt. Indicate the date you wish to *receive* the material in the "Date Required" box on the request form.

The *Printing Operation* produces forms, newsletters, manuals, and other printed material for most Digital facilities and offices as requested. A Printing Requisition form (EN-01023-05) must be filled out and signed by your cost center manager for work to be processed. If delivery times are critical, contact P&CS Customer Service well in advance. Contact the Customer Service Hotline (234-4297) for more information on job specification.

Mailing List Maintenance establishes and maintains a variety of mailing lists of Digital personnel, customers, and prospective customers. They also generate mailing labels and print-outs. To establish a new list, update a list, or obtain a print-out, fill out a Request for P&CS Mailing Services form (EN-1186A-05) and return it to Customer Services. The Customer Service Hotline (234-4297) can answer your questions.

The *Mailing Operation* provides complete mailing services to audiences within Digital, its customers, and prospective customers. They distribute periodicals such as Digital This Week (DTW), DECWORLD, and the Annual Report, as well as most of Digital's sales promotion literature and other communications. Smaller mailing distributions are handled when groups lack the resources to do them themselves. The Mailing Operation will also assemble notebooks, press kits, and other media upon request. For assistance from the Mailing Operation, fill out a Request for P&CS Mailing Services form (EN-1186A-05) and send it to Customer Services, or call the Hotline on 234-4297.

2 COMPANY POLICIES, STANDARDS, AND SPECIFICATIONS

DEC STD 001
This document is available from Standards and Methods Control, ML3-2/E56, 223-9475. In three sections it describes the corporate policy for Digital Standards and provides general information about the management and administration of the Digital Standards system. It describes the procedures required to create new standards and make changes to existing ones. It also describes the format and minimum content requirements for Digital Standards.

EL and 7665 Class Documents Index
This index to Digital Standards, Specifications, and Manuals is published periodically in the Engineering Newsletter and is also available from Standards and Methods Control, ML3-2/E56, 223-9475. Digital Standards and Specifications in the Index are arranged by number and areas of interest. The Index contains abstracts, responsible persons, departments, revision level, and date of revision.

Personnel Policies and Procedures
This manual is available from the Personnel Policy Group, PK3-1/C19, 223-4229. It contains corporate personnel notices and administrative procedures. Distributed to all personnel representatives and cost center managers on request.

Corporate Policy Memorandums
This document is available from Win Hindle, ML10-2/A53, 223-2276. It contains general information and guidelines regarding company operations policy. Distribution is restricted.

Software Development Policies and Procedures
This manual is available from Gladys Pannell, ML3-5/B39, 223-5860. It contains policies governing the process of developing software products, including plans, specifications, and a description of the phase review process. Available by subscription.

Computer Industry Standards Summary
This document (document number AA-H728B-TK) is available from the Software Distribution Center. It lists all information processing standards approved by the International Standards Organization (ISO), American National Standards Institute (ANSI), Federal Information Processing Standards (FIPS PUBS), European Computer Manufacturers Association (ECMA), and International Consulting Committee for Telegraph and Telephone (CCITT). Pending ANSI standards are also listed, with approximate completion and approval schedule. A short abstract is provided for ISO, ANSI, and FIPS standards. Call 234-4479 for a copy.

3 RAINBOW BOOKS

Rainbow Books are reports produced and distributed by various organizations in Engineering and Manufacturing. The following list identifies these reports by color and title, distribution, and responsible contacts.

Red Book
Central Engineering Long Range Product Forecast. This book is a five-year marketing and technology forecast for Central Engineering products. It is generated annually within each Central Engineering product development organization, and published by Corporate Product Management. Distribution is strictly controlled. Contact Rick Corben, ML12-1/T39, 223-3123.

Beige Books
Central Engineering Group Operating Plans. Beige Books are three-year operating plans generated annually by product development groups. They contain a base plan for product development, and supporting data such as product summaries and operating budgets. Distribution is controlled by individual development groups.

Blue Book
Manufacturing Management Report. Produced monthly, the Blue Book has limited distribution. Sections of the Blue Book referencing company plans of a highly confidential nature are strictly controlled. Available from Pete Bagg, ML1-4/P69, 223-8533.

Pink Book
Option and Basic System Actual Cost Report. Distributed quarterly, the Pink Book is strictly controlled and confidential. Available from Everett Carr, ML1-5/F31, 223-3841.

Brown Book
Product Line and Area Financial Statements. Produced monthly, the Brown Book has limited distribution and is strictly controlled. Available from Corporate Management Reporting, Barry Marshall, MS/F11, 223-9503.

Yellow Book
Engineering Product Status Report. Central Engineering groups report monthly on schedule, product content, and product development cost changes for each of their Baseplan items, and for various development efforts in Product Line engineering. Operations managers gather input from product managers, and forward it to Central Engineering Operations for publication. Distribution is strictly controlled. Contact Charles Picariello, ML12-1/T42, 223-2848.

Slate Books
Strategies by Process and Function, Planning and Budgeting
Produced periodically by managers of Manufacturing processes and functions. The books have open distribution. Contact Jim Melvin, AC/E48, 223-2310, for more information.

Polka Dot Book
Manufacturing's Report on New Products Being Introduced into Manufacturing. Produced quarterly, the Polka Dot Book has limited distribution and is strictly controlled. Available from Donna Allan, QI-1/E22, 280-7281.

4 FINANCIAL INFORMATION

Chart of Accounts
This document is available from General Accounting, Sharon Duggan, MS/K19, 223-4143. It contains general ledger accounts, cost center numbers, discrete project numbers, product line numbers, sales activity codes, and expense activity codes. Copies are usually sent to all cost center managers.

DEC Standard Price List and Addenda
This document is available from Reference Services, ZX, 253-2472. It is published quarterly on the first Monday of each fiscal quarter. Addenda are published monthly. Distributed on request.

5 GENERAL REPORTS AND DOCUMENTS

Component Index
This is a guide to purchased components in use at Digital. Primarily a design engineering tool, it is available in hard copy and microfiche. It is issued in three separate volumes: Multi-class, 90 class, and FCD (Functional Code Descriptor). Available from Helen Monsen, NR5/M2 234-4958.

DECUS Program Library
The DECUS Program Library, available to both Digital and outside DECUS members, is a clearing house for user programs. It provides a reproduction and distribution service only. No programming assistance can be given. If a program does not work as stated, the problem should be documented and sent to DECUS. It will be forwarded to the author for comment. If the program is deemed inoperable as stated by the author's documentation, the program will be removed from the library.

The description and availability of the software products described in the foregoing catalogues are subject to change without notice. Distribution shall be in accordance with the Standard Policy for each software product.

DECUS Program Library Catalogues

- PDP-11/VAX
- PDP-8, FOCAL 8, BASIC 8
- DECsystem-10 and DECSYSTEM 20

DECUS catalogues are published once a year. Updates are published in the quarterly newsletter DECUSCOPE. The following is a list of DECUS Program Library contacts:

- General Information: 231-4100
- Program Orders: Leslie Dube, MR2-3/E55, 231-4135
- Submissions and Program Information: Liz Clancy, MR2-3/E55, 231-4178

Document Control File (DCF)
This is an automated file with Engineering document number, description, revision, ECO pending, and site location data. For access, contact Carole Fiorentino, ML4-2/E27, 223-3931.

Market Data Center Memos
This index of new reports, recent findings, abstracts, and financial marketing reports is published monthly. Contact Pamela Gifford Hallaren, PK3-1/S52, 223-2504.

Minicomputer, LCG, VAX, and KS10 Libraries
Microfiche compilations of all Digital documentation useful to Field Service engineers. Library contains hardware manuals, diagnostics, and all maintenance-related documentation. Index to fiche is included. Available from Mary Antonelli, 249-4019, Bedford.

Option Module List
This document is available from June Payne, ML3-3/H14, 223-2912. It contains designations of all equipment which has been, is, or will be available for sale by Digital. The list is sorted by model number, and gives the responsibility for and status of each model number (including CSS and Software items) as well as a description and, generically, where it is used. Two versions of the list are published. Both are in hard copy and microfiche.

> *Version 1* is updated quarterly on hard copy and monthly on microfiche. Status 0 (cancelled), status 1 (unannounced), and status 7 (obsolete) entries are not shown. To be added to the distribution list, contact Jane Hanley (223-6493) or Karen Owens (223-2886).
>
> *Version 2* is updated monthly and is a complete listing of options and modules. The list is confidential and is distributed on a need-to-know basis. For a copy, contact Dick Best (223-2273) or June Payne (223-2912).
>
> A *Computer Special Systems* subset of all options and modules is also available on a need-to-know basis. Copies are available from Jane Hanley, ML3-3/H14, 223-6493.
>
> An *Option Module Software Subset List* is also available from Jane Hanley, ML3-3/H14, 223-6493. This list contains option numbers, responsible person, design engineer, product manager, manufacturing representative, status code, product category, description, and what it is used on. Distribution is monthly and restricted to a need-to-know basis.

Purchase Specification Microfiche
This data base contains purchase specifications on components purchased by Digital. It is available to the user at Specification Control Systems, NR5-2/P67, or through distribution by contacting Ann Byra, 234-4964.

Reliability Reports, Mean-Time-To-Repair Options, Summary Reports
This report contains detailed information from the field on systems and options. Available on request from Dori Cohen, PK3-2/S53, 223-2440.

System Software Information
Distributed to Field Service, Sales, and Software personnel, this manual is a reference guide for support information concerning Digital software products. It supplements information found in the software product descriptions. The manual is available from Gladys Pannell, ML3-5/B39, 223-5860.

VSMF (Visual Search Microfilm)
This is a subscription service containing vendor catalogue data on many products and technologies supplied by U.S. manufacturers. It is updated monthly and is available for viewing at Specification Control Systems. Contact Helen Monsen, NR5/M2, 234-4958.

The DEC Dictionary
The DEC Dictionary is designed to define the vocabulary of DEC English, a special language used in some technical writing at Digital. The purpose of DEC English is to decrease the number of words used in documents, making them more accessible to users, especially those not fluent in English. Documents written in DEC English are easier to translate, and may someday be machine-translatable. Contact Phyllis Walsh, BU/E31, 249-4112, for more information.

The JOBS Book
The JOBS Book is Digital's worldwide listing of available career opportunities. Employment organizations forward their job openings for publication. Published every two weeks, the books have sections on US Employment, Europe, and the General International Area. All positions are listed by function. The JOBS Book can help you discover new career opportunities, and contact organizations that can help you make career choices. The JOBS Book is available at several locations. Call Kathy Barnes, CF2-1/J10, 251-1030.

Field Sales Guide
The Field Sales Guide, marketed outside Digital as the Consultant's Reference Guide, is a 6-volume guide to all of Digital's products, services, and policies. Types of information include hardware and software data (configurators, technical summaries, Software Product Descriptions), descriptions of Digital service organizations, product lines and their offerings, technical overview charts, corporate history, sales and service locations, and referrals to a number of supporting publications. The Field Sales Guide/Consultant's Reference Guide is available in most Digital Corporate Libraries, or by calling 223-6955.

In-House Directory of Services
This booklet can help locate many of the services available within Digital. Entries are grouped by type of services, and are indexed and cross-referenced. Some of the topics are: Communications, Education and Training, Hardware Installation and Maintenance, and Standards and Procedures. The In-House Directory of Services is available from Internal DECUS, 231-6767.

Training Resource List
The Training Resource List is a compilation of education and training opportunities from many different sources. It includes workshops relating to Digital Information Systems, Engineering Technical Training, Field Service, Office Education, the Programmer Training Program, Sales Training, and many other groups. The Training Resource List is available from Joy Tucker, 223-9710.

6 COMPANY NEWSLETTERS

The list below represents only some of the newsletters published by Digital organizations. The intent has been to list those newsletters pertinent to Engineering personnel. To receive a newsletter, contact the corresponding responsible person.

Newsletters	*Contact/DTN*
Access (Manufacturing, Distribution & Control)	Catherine Hayward, 264-5712
Added Value (Technical OEM)	Linda Falvella, 223-9696
CAD Newsletter	Louise Lemaire, 223-5327

Newsletters	*Contact/DTN*
CLAS Software Dispatch	Diana Hallett, 223-5886
Consultant's Reference Guide Newsletter (New Products Marketing)	Pat Prevost, 223-6664
DECminster (Westminster Manufacturing)	Judy Shaughnessy, 241-4011
DECsystem-10 Bulletin and Dispatch	Diana Hallett, 223-8726
DECSYSTEM 20 Bulletin and Dispatch	Diana Hallett, 223-8726
DECUScope	Paula Morin, 231-4142
Digital Software News	Diana Hallett, 223-8725
Digital This Week	Available at all facilities
Digitimes(Field Service Manufacturing East)	Michele Barrett, 236-2586
DMS-11 Software Dispatch	Diana Hallett, 223-8725
Educational Computer Systems Newsletter	Jane Goldman, 272-3663
Engineering Newsletter	Karen Owens, 223-2886
ESG Headlines (Engineering Systems Group)	Gail Coutts, 231-6900
External Resources Newsletter	Maryann Reardon, 223-4749
IAS Software Dispatch	Diana Hallett, 223-8725
Inside Marlboro Manufacturing	Diane Lorion, 231-5627
Insight (VAX newsletter)	Pat Ward, 223-6600
Large Buffer (Software DEC 10/20)	Diana Hallett, 223-8725
Mainely DEC (Maine Manufacturing)	Pat Vinje 271-2328
Market Data Center Memo	Jerry Todd, 223-3631
MicroEclectic News	Molly Burton, 225-4821
Microware Newsletter	Bill Vaillancourt, 225-5027
MINC-11 Software Dispatch	Diana Hallett, 223-8725
Mountain Matter (Colorado Springs Manufacturing)	Sloan Devant, 522-3055
New Hampshire View (Merrimack Manufacturing)	Karen Rhine, 264-5003
Office Views	Rosie Rosenzweig, 223-6877
People Paper (West Springfield Manufacturing)	Carolyn Malloy, 244-2145
Personnel Newsletter	Andy Kurtz, 223-4229
Please Post - Library Newsletter	Corporate Library, 223-5821
Que Pasa? (Albuquerque Manufacturing)	Joyce Cardin, (505) 345-3311
Real Times (Internal DECUS and Internal Equipment Group Newsletter)	Joan Silverman, 231-6767
RSMX Software Dispatch	Diana Hallett, 223-8725
RSTS-E Software Dispatch	Diana Hallett, 223-8725
RT-11 Software Dispatch	Diana Hallett, 223-8725
Salem System Highlights (New Salem Manufacturing)	Sue Brander, 261-2455
Sights and Sounds (Woburn Manufacturing)	Michelle Barrett, 236-2586
Small Buffer (Software PDP-8/11)	Diana Hallett, 223-8725
Software Engineering News	Maddie Anastas, 223-2339
Software Tools Development and Methods	John Hrones, 264-8089

Newsletters	*Contact/DTN*
Specification Control Systems Biweekly Bulletin	Alice Daby 223-2275
Sun DEC (Phoenix Manufacturing)	Steve Speck 551-5484
The Minute Man Newsletter (Software Product Service)	Rosemary Eash, 223-8309
The Readout (Westfield Manufacturing)	Scott Danzig, 242-2622
Tidbits (Engineering Information Control Newsletter)	Rosalie Johnson, 223-2403
TMG Crossroads	Rochelle King, 259-3829
US Area News (US Field Personnel)	Nancy Settle, 223-8446
What's Up DEC (Burlington, Vermont Manufacturing)	Prudy Sullivan, 266-2244
Word's Out (Laboratory Data Products)	Jim Andrews, 264-5851

7 LIBRARY PUBLICATIONS

UPDATE – Corporate Library Newsletter
This monthly publication includes a select list of new books, reports, proceedings, and magazines received in the Corporate Library. It also includes current information on library activities and services, book reviews and special features. To be added to the distribution list, contact Jeanne Thompson, ML4-3/A20, 223-5038.

Library Link Lists
These are bibliographic compilations of the Corporate Library's collections on specific subjects, such as computer-aided manufacturing, small business computers, and data communication. Publication of these lists is irregular. Special topical requests can be researched. Contact the Reference Department, ML4-3/A20, 223-2695.

Other Digital Libraries
Contact individual site libraries in the Digital Library Network to discuss the availability of other local library publications, including newsletters and lists of periodicals.

8 DIGITAL COMMITTEES

Committees	*Contact/DTN*
Automated Drafting Systems	Allan Kent, 247-2429
Contracts Review	Steve Brace, 223-4491
Corporate Information Services Standards	Norm Horne, 223-5075
Critical Materials	Zoe Rae, 223-6727
DEC BASIC Standard	Tom Harris, 264-6779
DEC COBOL Standard	Bruce Miller, 264-6684
DEC Keyboard	Paul Nelson, 223-3528
DEC Standard 012 Steering	Joe Kurta, 223-8895
Design Services Steering	Dick Reilly, 223-2982
Diagnostic Engineering Managers (DEMC)	Warren Moncsko, 223-4080

Committees	*Contact/DTN*
Engineering	Allan Kent, 247-2429
Engineering Board of Directors	Bill Long, 223-2819
Environmental	Ed Spuler, 264-6720
Finance/Administration	John Fisher, 223-1933
Group Manufacturing/Engineering	Frank Cassidy, 231-5317
Group Vice Presidents	Ted Johnson, 223-5942
Language Standards	Jeff Rudy, 264-6680
Low End Research and Development	Jesse Lipcon, 223-3207
Major Contracts Review	Royce Fuller, 251-1514
Manufacturing/Engineering	John Holman, 223-5533
Marketing Task Force	Glenn Reyer, 264-5974
Office of Development	Gordon Bell, 223-2236
Operations	Win Hindle, 223-2338
Order Administration	Denny Bjork, 253-2518
Order Administration Managers	Les Norman, 231-5811
PASCAL Internal Standards	Leslie Klein, 247-2653
Patents	Ron Reiling, 223-2991
Personnel	Shel Davis, 223-2838
Personnel Policy Development	Andy Kurtz, 223-4229
Personnel Systems Management	Romney Biddulph, 223-4166
Personnel Systems Working	Jeff Singer, 223-6557
Pricing Policy	Ted Johnson, 223-5942
Printed Circuit Communications	Joe Kurta, 223-8895
Producibility	George Ross, 232-2596
Product Safety	Carlton Davenport, 223-6554
Public User Body (PUB)(CAD Users)	Don DiMatteo, 223-2438
Quality Board of Directors (QBOD)	Art Sturgis, 223-6950
Research and Advanced Development	Lorrin Gale, 223-5703
Technology Managers Committee	Bob Glorioso, 223-5250
Test Measurement Equipment Center	Bill Norris, 242-2238
VAX Architecture	Dileep Bhandarkar, 247-2021
VAX Layered Products	Tom Hastings, 264-6767
VAX New Products	Mike Powell, 247-2856
Wirewrap Communications	Joe Kurta, 223-8895
Workmanship	Bill Yadlon, 232-2497

9 DIGITAL TELEPHONE DIRECTORY

The Digital Telephone Directory contains a plethora of information about the many resources available to you at Digital. The directory is available to all employees at Office Supplies Stockrooms throughout Digital's facilities. Your department secretary can direct you to the proper source or get one for you.

The following information and procedures are contained in the directory:

- North American Customer Assistance
  - Extension and location
  - Important numbers to know within Digital facilities in Massachusetts
- How to update your listing
- Metropolitan Boston Telephone Service

- Dialing instructions for
    - Digital Telephone Network (DTN)
    - WATS lines
    - Metropolitan Boston
    - Long distance
    - International calls
    - Local calls
- Special Telephone Services
    - Credit Card calls
    - Telephone service requests
    - Conference calls
    - Transferring calls
- Corporate Message Services (RCS)
- International Suggested Calling Times
- World Holidays
- Domestic Suggested Calling Times
- Mail Services
    - Post Office
    - Interoffice
    - Field Office
    - Mail arrival/departure schedules
    - Special Services
    - General Information
- Location Codes
- Order Processing Groups
- Personnel Listing
- Departmental Listing
- Domestic Office Listing
- European Listing
- General International Area Listing
- International Distributors
- Emergency Numbers

10 TRANSPORTATION

Interplant
Aircraft and van transportation services are available to and from the various Digital facilities in the New England area. Van schedules are posted on bulletin boards through facilities. Aircraft schedules are posted at the entrances to the facilities and paper fliers are available from receptionists or security guards. Scheduled freight flights (allowing up to 2 passengers) leave Boston every Saturday afternoon for Dublin, Ireland and Frankfurt, Germany. Contact Parker Street travel at 223-5522 for reservations and information.

Commuter
Digital encourages employees to form car pools and van pools to travel to and from work. In fact, Digital will provide a commuter van to anyone who can round up at least 10 riders including a driver. If you are interested in joining a car pool or a van pool, or starting either one yourself, contact the Commuter Transportation Department, CF/B88, 251-1525.

11 EMPLOYEE EDUCATION AND TRAINING

Employee education exists to improve employee job performance by delivering quality education products in a timely, cost-effective manner. General training is open to any employee on a first-come, first-serve basis. The organization offers total programs for groups such as Software Services, Digital Information Systems, and Field Service. They also provide programs for specific job functions such as clerical skills, word processing training, software training, hardware training, and a variety of other programs.

Courses are scheduled at Bedford and other Digital facilities. On-site courses are available by arrangement. Self-paced instruction and audio-visual courses are offered at six Individualized Learning Centers: Maynard; Bedford; Princeton, New Jersey; Rolling Meadows, Illinois; and Los Angeles.

Lecture/lab software courses cover VAX/VMS, RSX, RSTS, DECsystem-10/DECSYSTEM 20, BLISS language, Standard Editor, etc.

New and current users of Word Processors can obtain introductory, basic, intermediate, and advanced courses. Users of the DECsystem-10 and DECSYSTEM 20 can learn the hardware, software, and overall capabilities of the systems as well as specific skills like text formatting and editing. In communications, courses are offered on the Internal Message Switching system (RCS) and the Electronic Mail System (EMS).

The *Employee Education Course Schedule*, published quarterly, details offerings at US locations, announces new courses, and contains information about current educational resources. This publication is sent to all US cost center managers, personnel representatives, and personnel service administrations. If you need a copy, contact the Schedule Editor, BU/E54, 249-4396.

The *Employee Education Catalogs* are published every 12 to 18 months and contain complete descriptions of course contents, prerequisites, and objectives. Separate catalogs exist for Field Service, Software Services, and Office Education courses. For more information about courses, call Employee Education Marketing, 249-4300.

APPENDIX A

How To Protect Digital's Intellectual Property

Digital is a high technology company and a leader in the computer industry. To maintain this leadership, Digital must continue to develop and protect its various forms of proprietary information and knowledge. Such information and knowledge can take the form of ideas embodied in products (both hardware and software), processes to build, assemble, or test those products, business information concerning sales and marketing figures, published information contained in books, manuals, engineering drawings, and other internal information such as new product planning strategies and developments.

Each piece of such information is a valuable asset. Not only can it give Digital a competitive advantage in the marketplace, it could be very valuable data to our competitors. It is, therefore, of the utmost importance that each employee, and in particular those employees dealing with research or product development, be aware that Digital's knowledge and know-how must be properly safeguarded from competitors.

Digital protects its proprietary information, often referred to as intellectual property, by using various methods provided by law. There are four principal areas of intellectual property law to protect this information, namely, patents, trademarks, copyrights, and trade secrets. Several attorneys form part of Digital's Law Department and are responsible for servicing Digital's Engineering groups, particularly with respect to matters involving intellectual property. When issues are raised involving patents, trademarks, copyrights, and trade secrets, the attorney responsible for the particular engineering group should be contacted. If a potential problem is recognized involving Digital information and the attorney is contacted, measures can be taken to adequately protect Digital's information.

The following is a brief overview highlighting the basic concepts involved in the law of intellectual property. It is intended to aid you in spotting these intellectual property issues.

Patents

Congress has passed laws to protect idea information. One form of idea information, inventions, is protected by patents. The grant of a patent is in effect a contract between the government and an inventor. In exchange for a public disclosure of an invention, the government grants the inventor the right to exclude others in this country from making, using, and selling the invention for 17 years. Similar provisions apply in other countries.

An engineer, in the course of his or her work, may develop an "invention" (a new and useful mechanism, article, or method) that has a degree of novelty or uniqueness greater than what a skilled technician or engineer would develop in performing his or her day-to-day work.

It is important for you to continually review your work to determine whether it qualifies as an invention. You are not expected to know whether the invention is patentable or not. The cognizant attorney will determine this. However, you should be able to identify those things that contain some ingenuity and that, to your knowledge, were not previously known or invented by someone else. Once it has been established that an invention has been developed, the invention should be disclosed to the Law Department.

To aid in the protection of inventions incorporated in our products, Digital has established a Patent Committee responsible for determining whether or not to file patent applications on inventions made by Digital personnel. The committee has formulated a basic patent policy under which Digital will attempt to find (and file patent applications for) at least one patentable invention in each product we expect to sell in volume. A patent on our important products may range from protecting a feature in the product to the entire architecture of the product. Although the company is more likely to file for patents on inventions actually incorporated in products, Digital will file for patents on other inventions.

Since the grant of a patent is dependent upon the invention meeting certain timing criteria established by the law, all inventions considered for patenting should be brought to the attention of the Law Department before any disclosure outside the company. This would typically be at the prototype or breadboard stage, or before they are incorporated into products that are announced, shipped, or described in publications. When an invention disclosure is submitted, the cognizant attorney should be advised as to when a public use, sale, or publication of the invention is contemplated.

Patents obtained by Digital are used to prevent other people from making the product. Digital also licenses the use of some of its patents so it is paid a royalty for each product made which is covered by the patent. Business factors will determine if we should share the idea by licensing others to use it.

As part of your responsibility to protect new ideas of the company, all personnel performing scientific or technical work in the fields of research, development, and engineering should maintain accurate and complete records of their work. The purpose of maintaining these records is to have a legal record to substantiate the conception of inventions covered by patent applications. The Digital Engineering Notebook system is a valuable tool developed for this purpose. It is the responsibility of Digital technical personnel to maintain Engineering Notebooks, particularly in those instances involving a description of a development that may be patentable.

Trademarks

A trademark is one or more words, a name, symbol, device, or slogan used by a manufacturer to indicate the source of the goods or services and to distinguish his or her goods and services from those of others. Digital trademarks inform the customer that the product was manufactured by Digital and not someone else. By using a trademark, the owner of the trademark is, in effect, guaranteeing that the trademark product is of the same quality as similarly trademarked products acquired in the past. A trademark is a valuable asset since it provides a highly recognizable link between a customer and the products of the company.

Digital has invested significant amounts of money to associate its trademarks with its products. Marks such as DEC, DECUS, PDP, and the Digital logo are well recognized in the industry and throughout the industrial world. However, trademarks must be protected or they can be lost. It is relatively easy to protect and care for trademarks. The following is a list of some of Digital's more prominent current trademarks:

DEC	**DIBOL**	**PDT**
DECnet	**Digital logo**	**RSTS**
DECSYSTEM 20	**EduSystem**	**RSX**
DECsystem-10	**IAS**	**UNIBUS**
DECUS	**MASSBUS**	**VAX**
DECwriter	**PDP**	**VMS**
	VT	

In addition, Digital is constantly coining new marks. Before a new trademark is announced or used, it should be submitted to an attorney for a trademark infringement search. This will help us to determine if our new trademark will infringe a trademark already belonging to someone else. By having the trademark search performed early, most legal problems will be found before the company incurs advertising and other costs.

If you encounter any suspicious use of our trademarks by a party outside of Digital, or are planning or participating in the process of choosing a trademark for a new product or service, an attorney should be advised.

Copyright

A copyright is a legal right to prevent others from making copies of an author's work provided the work is marked with a proper copyright notice when published. However, a copyright does not protect an author's ideas. It protects only his or her individual expression of those ideas. Ideas expressed in a copyrighted work may be freely used by anyone; however, if someone copies the same expression or modifies it slightly, he or she is not free to use the copy or modification.

Digital information protected by copyright is generally written information. This includes engineering drawings, software, and manuals, but may also be audio-visual training courses and other items. Under the law, as long as we put a copyright notice on our publication (a "c" within a circle, year of publication and owner, for example, © 1979 Digital Equipment Corporation) we have performed the minimum procedures required to obtain copyright protection. DEC STD 197, *Legal Guidelines for Digital Publications*, contains requirements for controlling proprietary information and protecting Digital against liability.

At Digital we make a substantial investment in copyrighted information that we publish. We disseminate to our customers a great deal of desired information about our products. At the same time, we use the exclusivity that copyright laws provide to prevent unfair use of our publications. Such unfair use occurs when a similar product is made by a competitor and our copyrighted material is used to describe the similar product.

You should, therefore, be aware that any written works that are expected to be published must have appropriate copyright protection. In the same manner, we must be careful not to violate the copyright of others when we are using their works.

Trade Secrets

In some situations the patent system is not a suitable method of protection for a company's products or processes. A commonly used alternative is to protect the intellectual property as a trade secret.

The law of trade secrets is based on the recognition that it is unjust to permit the misappropriation of technical or commercial know-how that is not in the public domain. The law provides a legal right to prevent, or to recover damages for, an unauthorized disclosure or use of technical or commercial information that is a trade secret. A trade secret may be any confidential formula, pattern, device, or combination of information used in one's business that gives him or her an opportunity to obtain an advantage over competitors who do not know or use it.

A trade secret must be kept "secret" so that it does not become publicly known. A trade secret may be lost by disclosure to others without any limitations. However, the law of trade secrets can be extended into the marketplace by means of contractual arrangements binding the recipient of information to keep it secret.

To adequately prevent a trade secret from becoming publicly known, appropriate internal procedures must be undertaken. These procedures should include as a minimum:

a. insuring that trade secret information is not provided to customer or vendors except under appropriate agreements;

b. restricting access to the information to those employees and agents having a "need to know" and informing those employees and agents having access to the information that it is confidential; and

c. maintaining general security precautions on the premises, avoiding leaving confidential information in open or uncontrolled areas, restricting access to those locations having sensitive information, and so forth.

Digital invests a great deal of money and resources to develop its software as well as its hardware products. Because the software products, once on the market, are easily reproduced and copied (the vast number of delivered Digital computers are a ready market for Digital software), it is important that our company legally protect its software products against improper duplication and distribution. Digital has elected to protect its software by both copyright and trade secret theories, with patent protection also attempted in rare cases.

A software license agreement is the legal vehicle under which our customers are licensed to use the trade secrets and copyrights incorporated in our software. Without some form of license agreement, our trade secrets and copyrights in our software products may not be protected when software is provided to customers. For this reason, Digital places extreme importance in providing our software only under an appropriate licensing agreement.

Sometimes during the course of business we may disclose trade secret information that relates to new products before they are announced. If a business decision is made to disclose Digital information, an appropriate non-disclosure agreement must be signed by the recipient. Although the non-disclosure agreement provides some protection, the best protection, of course, is not to disclose the information. Once released by an outside party, whether accidentally or deliberately, Digital confidential information may become public property and subject to unrestricted use. The first approach always should be to try and find a way to conduct transactions without disclosing or transmitting Digital confidential information. This is particularly true for very sensitive and highly proprietary information.

Just as we do not want to disclose our confidential information without restrictions, neither do our customers and vendors. At times we may visit a customer's plant or see what is going on in his or her business, and often the customer may ask us to execute a non-disclosure agreement to protect his or her trade secret information. This is a dangerous situation. We are a large company with a great deal of internal development work. Also, we are exposed to a large number of ideas from our customers. If we internally develop or receive an idea from a third company which resembles information received under a non-disclosure agreement, Digital's legitimate use of the idea could compromise the customer's proprietary information, even if we have not done so.

It is Digital's general policy not to execute non-disclosure agreements. We refuse to receive any trade secret information submitted to us from companies or persons outside of Digital. If for significant business reasons an exception to this policy must be made, then a specific non-disclosure agreement must be negotiated by the Law Department. An appropriate Vice President must sign the agreement on behalf of Digital.

It must be remembered that all Digital employees are obliged to respect the trade secrets of former employers. Thus, no person at Digital is to be given any information which one has reason to believe is a trade secret of a former employer.

The foregoing should aid in the understanding of how and why Digital protects its information. As individual employees, we can each contribute to the protection of Digital information by accepting the following responsibilities:

a. Reviewing our work to determine whether we have developed an invention, maintaining good records concerning the facts related to such inventions, and submitting innovative ideas to the Law Department;

b. Appreciating the fact that all Digital intellectual property, including trademarks and copyrights, are valuable assets and should be properly cared for;

c. Taking appropriate precautions to maintain in confidence Digital's trade secret information so that it is not disclosed outside the company without proper protecting agreements; and

d. Avoiding receipt of confidential information from outside Digital and contacting the Law Department if such receipt is felt to be justified by significant business reasons.

If you have any questions concerning the above, feel free to contact a lawyer in the Law Department.

APPENDIX B

ACRONYMS

This list of technical and other acronyms used in this manual and around Digital was compiled with the help of the DEC Dictionary.

AA	Affirmative Action
A&SG	Accessories and Supplies Group
ACK	Acknowledge
ACM	Association of Computing Machinery
ACT	Automated Computer Testing
ACU	Automatic Calling Unit
A/D	Analog-to-Digital
ADC	Analog-to-Digital Converter
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
ALGOL	ALGOrithmic Language
ALM	Assembly Library Module
ALU	Arithmetic Logic Unit
AM	Amplitude Modulation
AMS	Administrative Management Systems
AMT	Automated Module Test
ANL	Analog Loop

ANSI	American National Standards Institute
A/P	Accounts Payable
APL	A Programming Language
APST	Automatic Power Supply Test
APT	Automated Product Test
A/R	Accounts Receivable
ASAP	As Soon As Possible
ASCII	American Standard Code for Information Interchange
ASSIST-11	Directory Assistance System
AWT	Automatic Wire Tester
BAC	BAsic program Compilation
BAS	BAsic program Source
BASIC	Beginner's All-purpose Symbolic Instruction Code
BCD	Binary Coded Decimal
BFO	Beat Frequency Oscillator
BIMS	Branch Inventory Management System
BLISS	Basic Language for Implementation of System Software
BOD	Board of Directors
BOM	Bill of Materials
BOT	Beginning of Tape/Transmission
BPG	Business Products Group
BPI	Bits Per Inch
BS	Back Space
CAD	Computer Aided Design
CAI	Computer Aided Instruction
CALDEC	Computer Aided Layout by DEC
CAM	Computer Aided Manufacturing

CAN	Cancel
CAR	Carrier
CBL	COBOL source file extension
CBR	Console Bus Request
CC	Cost Center
CCEG	Central Commercial Engineering Group
CCITT	Comite Consultatif Internationale de Telegraphie et Telephonie, a committee which sets international communications standards.
CCL	Concise Control Language
CCS	Computer Control Store
CCS	Configuration Control Switch
CDC	Corporate Data Center
CER	Central European Region
CIS	Corporate Information Services
CMOS	Complimentary Metal Oxide Semiconductor
CMS	Corporage Message System
CNPR	Console Non-processor Request
COBOL	COmmon Business Oriented Language
COD	Central Order Desk
CODASYL	Conference on Data Systems Languages
COG	Corporate Operations Group
COS	Commercial Operating System
CPG	Commercial Products Group
CPR	Certified Paths of Restraint
CPU	Central Processing Unit
CR	Carriage Return
CR	Central Region
CRT	Cathode Ray Tube

CSA	Canadian Standards Association
CSI	Computer Services Industrial Group
CTS	Clear to Send
CSS	Computer Special Systems
CSR	Control/Status Register
D/A	Digital-to-Analog
DAA	Data Access Arrangement
DAA	Direct Access Arrangement
DAC	Digital Assistance Center
DAM	District Administrative Manager
DAR	Device Address Register
DCG	Digital Components Group
DBMS	Data Base Management
DDC	Digital Diagnostic Center
DDT	Dynamic Debugging Technique
DDP	Distributed Data Processing
DDP	Distributed Data Products
DDT	Dynamic Debugging Technique
DEC	Digital Equipment Corporation
DECnet	DEC Networking Software
DECUS	Digital Equipment Computer Users Society
DFAM	District Finance and Administration Manager
DIBOL	Digital Business Oriented Language
DIBS	Digital Integrated Business Systems
DM	District Manager
DMA	Direct Memory Access
DMT	Design Maturity Test

DOAM	District Order Administrative Manager
DOS	Disk Operating System
DPM	Data Path Module
DPM	Distributed Plant Management
DPSK	Differential Phase Shift Keying
DS	Datasystems
DSO	Days Sales Outstanding
DSPL	DEC Standard Price List
DSR	Data Set Ready
DTL	Data Terminal Loop
DTN	Digital Telephone Network
DTR	Data Terminal Ready
DTW	*Digital This Week*
DVT	Design Verification Test
EAE	Extended Arithmetic Element
EBCDIC	Extended Binary Coded Decimal Interchange Code
EBOD	Engineering Board of Directors
ECC	Error Correction Code
ECL	Emitter Coupled Logic
ECO	Engineering Change Order
ECP	Engineering/Computation Product Line
ECS	Education Computer Systems
EBOD	Engineering Board of Directors
EDP	Electronic Data Processing
EEO	Equal Employment Opportunity
EHQ	European Headquarters or Geneva
EMC	European Marketing Committee

EMI	Electromagnetic Interference
EMS	Electronic Mail System
EOF	End Of File
EOJ	End Of Job
EOM	End Of Message/Medium
EOM	End Of Medium
EON	End Of Number
EOT	End Of Transmission/Tape
EPG	Education Products Group
EPLS	Engineering Product Library Systems
EPROM	Erasable Programmable Read Only Memory
ESE	European Software Engineering
ESG	Engineering System Group
ESS	Electronic Switching System
ETX	End Of Text/Transmission
F&A	Finance and Administration
FA&T	Final Assembly and Test
FCI	Flux Changes per Inch
FCO	Field Change Order
FCS	First Customer Ship
FDM	Frequency Division Multiplexing
FDX	Full Duplex
FET	Field Effect Transfer
FIFO	First In First Out
FIPS	Federal Information Processing Standards
FM	Frequency Modulation
FORTRAN	FORmula TRANslator

FPA	Floating Point Accelerator
FP & E	Facilities Planning and Engineering
FPP	Floating Point Processor
FR	Flux Reversal
FRED	FoRms EDitor
FS	Field Service
FSK	Frequency Shift Keying
F/U	Follow Up
FY	Fiscal Year
FYI	For Your Information
G&A	General & Administrative
GA	Graphic Arts
GCR	Group Code Recording
GIA	General International Area
GIS	Government Information Systems
GM	Gross Margin
GND	Ground
GT	Graphics Terminal
HDX	Half Duplex
HEX	Hexadecimal (H)
HOSS	Home Office Software Services
HS	High Speed
IAS	Interactive Applications System
IC	Integrated Circuit
IDACS	Industrial Data Acquisition Control System
IDEA	Interactive Design Engineering and Automation

IHFS	In House Field Service
ILC	Individual Learning Center
INIT	Initialize Input/Output
I/O	In/Out, Input/Output
IPC	Information Processing Center
IPCF	Inter Process Communication Facility
IPG	Industrial Products Group
IPS	Inches Per Second
IPS	Information Processing Services
IRL	Information Retrieval Language
ISG	Information Systems Group
ISO	International Standards Organization
JCS	Job Control Sheet
JV	Journal Voucher
LARS	Labor Activity Reporting System
LCEG	Large Computer Engineering Group
LCG	Large Computer Group
LDP	Laboratory Data Products, Laboratory Data People, etc. DEC's people and products for the lab research market.
LED	Light Emitting Diode
LIFO	Last In First Out
LP	Line Printer
LQP	Letter Quality Printer
LR	Limited Release
LRC	Longitudinal Redundancy Check
LSI	Large Scale Integration
LTC	Line Time Clock

MACRO-10	Assembly Language for DECsystem-10/20
MACRO-11	Assembly Language for PDP-11
MAR	Mid-Atlantic Region
MBA	MASSBUSS Adapter
MC	Marketing Committee
MDC	Market Data Center
MDG	Market Development Group
MDP	Medical Data Products
MIS	Management Information Services
MLP	Maynard List Price
MOS	Metal Oxide Semiconductor
MPF	Master Parts File
MPS	Micro Processing Systems
MRC	Module Repair Center
MSB	Most Significant Bit
MSD	Most Significant Digit
MSG	Medical Systems Group
MSR	Marketing Support Representative
MTBF	Mean-time Between Failure
MTP	Maynard Transfer Price
MTTR	Mean-time To Repair
MUMPS	Mass General Hospital Utility MultiProcessing System
MUX	Multiplexer
NC	Numerically Controlled
N/C	Numerical Control
NDSC	New DEC Salesman Course
NER	Northeast Region

NOR	Normalize
NOR	Net Operating Revenue
NOP	No Operation
NPG	Non-Processor Grant
NPR	Non-Processor Request
NPSU	New Product Start Up
NRZ	Non-Return to Zero
NRZI	Non-Return to Zero Indiscrete
OD	Organizational Development
ODT	Octal Debugging Technique
OEM	Original Equipment Manufacturer
OL-BS	On-line Budgeting System
OOD	Office of Development
OS	Operating System
OS/S	Operating System for PDP-8
PAL	Programming Assembly Language
PAM	Pulse Amplitude Modulation
PB	Parity Bit
PC	Printed Circuit/Program Counter
PCBA	Printed Circuit Board Assembly
PCB	Printed Circuit Board
PCA	Printed Circuit Assembly
PCM	Pulse Code Modulation
PDM	Pulse Duration Modulation
PDP	Programmed Data Processor
PE	Plant Engineering
PE	Phase Encod/ed/ing

PG	Program Generated
PIP	Peripheral Interchange Program
PK	Parker Street
PL	Product Line
P & L	Profit and Loss Statements
PM	Phase Modulation
PMR	Powder Mill Road Building
PMT	Process Maturity Test
PNRF	Part Number Request Form
PO	Purchase Order
POS	Point Of Sale
PP	Papertape Punch
PPL	Purchased Parts List
PPM	Pulse Position Modulation
PPN	Project Programmer Number
PR	Production Release
PRC	Product Repair Center
PROM	Programmable Read Only Memory
PRTLST	Parts List
PS	Programming Systems
PSA	Personnel Service Administrator
PS/8	PDP-8 Programming System
PSG	Product Steering Group
PSK	Phase Shift Keying
PUN	Punch
QAM	Quadrature Amplitude Modulation
Q1, Q2. etc.	Quarter 1 of Fiscal Year, Quater 2, etc.

QC	Quality Control
QTD	Quarter To Date
QVL	Qualified Vendor List
RAM	Random Access Memory
RAMP	Reliability And Maintainability Program
RD	Remote Diagnosis
RDL	Remote Digital Loop
R&D	Research and Development
RFM	Regional Financial Manager
RFP	Request For Proposal
RFQ	Request For Quote
RIL	Restricted Items List
RJE	Remote Job Entry
RM	Regional Manager
ROAM	Regional Order Administrative Manager
ROI	Return on Investment
ROM	Read Only Memory
RSTS	Resource Sharing Timesharing System
RT	Real Time
R-T/C	Real-Time/Computation
RTS	Real Time System
SABER	Subsidiary Accounting Budgeting Expense Report
SAGE	Simulation of Asynchronous Gate Elements
SBA	Shipping Billing Authorization
SCAN	An automated system for retrieval of printed information
SCB	System Control Block
SCCB	System Control Base

SDC	Software Distribution Center
SDLC	Synchronous Data Line Control
SDP	Software Development Policy
SDS	Software Distribution Services
SI	International Metric System
SJV	Standard Journal Voucher
SMC	Software Services Management Committee
SPD	Software Product Descriptions
ST	Self Test
STUDD	Simulator and Tester Usage for Design and Diagnostics
STX	Start Of Text
SUDS	Stanford University Design System
SWAB	Swap Byte
SWS	Software Services
SYSGEN	SYStem GENeration
SYSLIB	SYStem LIBrary
SYSTAT	System Status
T & Cs	Terms and Conditions
TDM	Time Division Multiplexing
TEM	Test Equipment Manufacturing
TELCO	Telecommunications Industry Group
TEMP	Temporary
TMS-11/CMS-11	Text Management System/Classified Management System
TOPS	Total Operating System
TPG	Terminals Product Group
TPL	Traditional Product Line
TPS	Transaction Processing Systems
TRS	Time Reporting Systems

TTL	Transistor Transition Logic
TU	Tape Unit
UBA	UNIBUS Adapter
UBI	UNIBUS Interface
UET	UNIBUS Exercise Terminator
UDC	Universal Digital Controller
UL	Underwriter's Laboratory
VAX	Virtual Address eXtension
VCD	Variable Center Distance
VMS	Virtual Memory Storage
VSAM	Vestigal Sideband Transmission
VT	Video Terminal
WC	Wage Class
WCS	Writeable Control Store
WIP	Work In Progress
WP	Word Processing
WPS	Word Processing Systems
WR	Western Region
WS	Word Station
WT	Word Terminal
YTD	Year To Date

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Your comments and suggestions will help us in our continuous effort to improve the quality and usefulness of our publications.

What is your general reaction to this manual? In your judgment is it complete, accurate, well organized, well written, etc.? Is it easy to use? ______

What features are most useful? ______

What faults or errors have you found in the manual? ______

Does this manual satisfy the need you think it was intended to satisfy? ______

Does it satisfy *your* needs? ______ Why? ______

☐What kinds of information would you like to see in the next edition of the Engineering Orientation Manual?

______

Additional copies of this manual are available from:

Standards and Methods Control
ML3-2/E56
223-9475

For all orders, include your name, badge number, location, date, cost center number, catalogue order number, quantity, and description.

Order No. EL-ENGRS-OM-000

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Send to:

Digital Standards Administration

ML3-2/E56

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I n t e r o f f i c e   M e m o

TO: DISTRIBUTION

DATE: December 12, 1988
FROM: Jim Cudmore, VP Engineering Product Operations
DEPT: Product Operations
EXT: 223-6923
LOC/MAIL STOP: MLO12-2/U33
ENET: @CORE

The Corporate Phase Review process is one of the principal tools used in the Company to help us plan, coordinate, manage, measure, and communicate during the life cycle of our products. We started using this process in the mid 1970's and over the years, it has been updated to incorporate new learnings and maintain congruency with how we do business.

The enclosed guide is a result of our continued effort to simplify the process, encourage more predictability, collaboration, flexibility, and discipline in product life cycle management. The specific changes we have made to the process are as follows:

1. Established Phase 1 exit as the Company's commitment to the product's function, cost and schedule.

2. Modified DEC STD 130 [Product Business Plan Requirement] and made the Phase 1 Business Plan the "Business Plan of Record" against which the business success of the product is measured.

3. Created a TOP 100 process, to provide more corporate visibility and management support for products critical to the Company's longer term survival.

4. Modified DEC STD 028 [Phase Review Policy] to clarify the intent of the process and articulate the Company's expectations of the roles played by the major functions involved in product life cycle management.

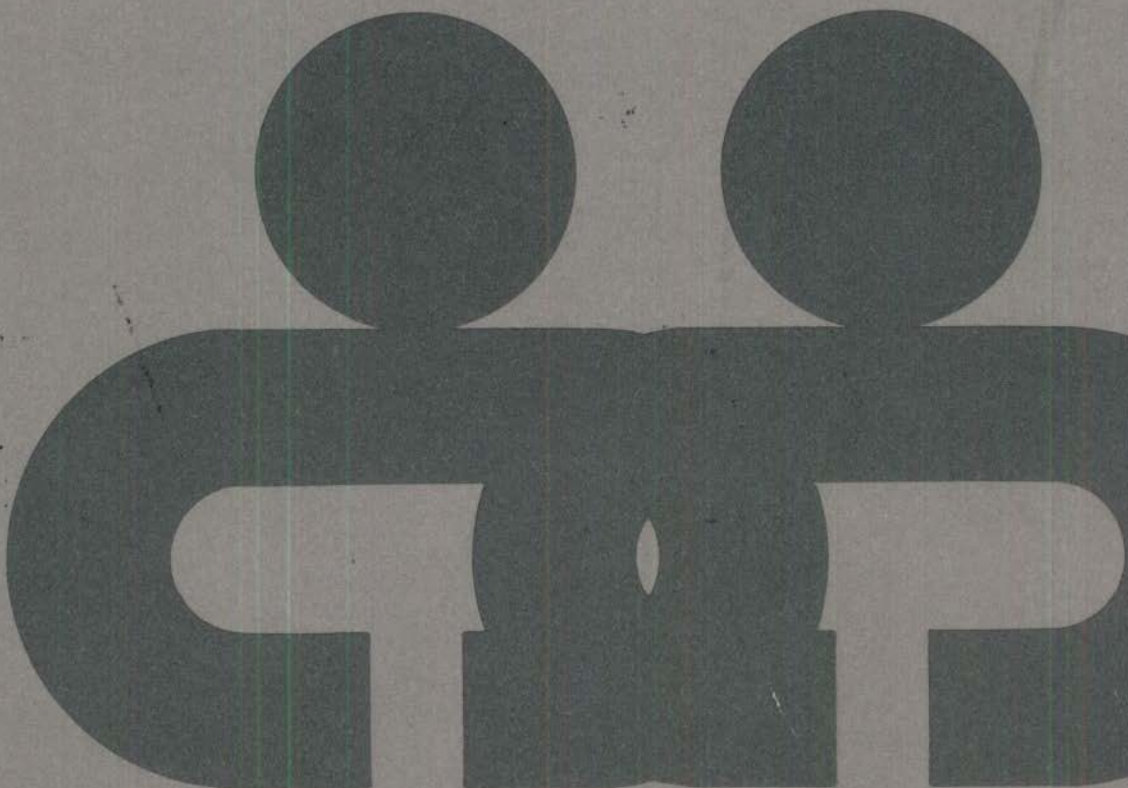
The guide was developed by a cross-functional team and reflects the commitments made by each function to support smooth implementation of the process and eliminate surprises. The guide clarifies areas of responsibilities, focuses on deliverables and actions necessary to fulfill the requirements of each phase. It does not tell you how to do your job. Ownership of how the work gets done resides in the responsible group. It is important that individual organizations develop their own management processes which reflect the needs of their individual businesses. Our expectation is that these processes will mirror the spirit and structure of the Phase Review Process.

The guide does not have all the answers and is not a substitute for good management. It should not be used to stifle creativity or hinder progress, and is most helpful where used within the spirit of the process. Please feel free to contact Walter Soltysik, PTO::Soltysik with constructive suggestions for future revisions.

Regards,

Jim Cudmore

Corporate Phase Review Process Guide



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CORPORATE PHASE REVIEW PROCESS GUIDE

DOCUMENT IDENTIFIER: A-MN-ELCP356-00-0 Rev B, 08-Dec-1988

ABSTRACT: The Corporate Phase Review Process Guide provides guidelines that assist cross-functional Product Teams in:

- Planning for and controlling products during their life cycle.
- Using a common language to communicate project status.
- Promoting consistency in what is expected during the life cycle of products.
- Identifying responsibilities for meeting requirements of the Corporate Phase Review Process.

This guide offers concise guidelines for general application from product inception to product phase down.

APPLICABILITY: This guide applies to all product development efforts and is to be used by members of the Product Team and individuals within the Corporation who support these functions and their Team representatives during the product's life cycle.

The Phase Review Process is dynamic and flexible. However, it cannot stand alone and must be applied judiciously with sound management practice. The level of detail necessary to satisfy the Phase Review Process requirements is product dependent. Groups that supplement the information in this guide with their unique requirements will derive maximum benefit from the process.

STATUS: APPROVED 08-Dec-1988; see EL-INDEX for expiration date.

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TITLE: CORPORATE PHASE REVIEW PROCESS GUIDE

DOCUMENT IDENTIFIER: A-MN-ELCP356-00-0 Rev B, 08-Dec-1988

REVISION HISTORY:	Rev A,	23-Jan-1982	
	Rev B,	08-Dec-1988	ECO #CT001

Note
Rev A was released as EL-EN356-00.

Document Management Category:	Product Management Process Requirements (TPR)
Responsible Department:	Engineering Product Planning Group
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APPROVAL: This document has been approved by Engineering Product Planning for use throughout Digital.

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"All of the battles will be fought, discussions held, compromises reached, and the company committed before we make large investments in Engineering, Manufacturing, Marketing, and the Field."

Jack Smith
28–Jan–1985

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Preface

PURPOSE OF THE GUIDE

This guide provides a framework that enables the Product Team to develop and communicate mutual commitments to product plans, and to execute those plans in accordance with agreed–upon objectives and schedules as required by *DEC STD 028–0 The Corporate Phase Review Policy*. It is also a reference for individuals or groups who support the Product Team or who need a working knowledge of the Phase Review Process.

SCOPE

This guide should be used by all groups involved in product life cycle activities. The Phase Review Process shall be used whenever a specific product is being contemplated, but need not be used in its entirety when technical concepts are being evaluated without a specific product in view.

This guide provides a clear and concise structure of who is involved, what their responsibilities are, and when these requirements shall be executed. It is NOT intended to explain HOW a specific group or organization meets these requirements.

TARGET AUDIENCE

The primary audience for this guide is the Product Team and supporting functions involved in product life–cycle management. A copy of this guide should be made available to each Product Team member.

HOW TO USE THIS GUIDE

The purpose of this guide is to help Product Teams successfully execute the requirements of the Phase Review Process. To accomplish this goal, the guide has been designed in a modular fashion to explain each function's responsibility, objectives, exit criteria, and activities for each phase. Memory joggers and outlines of required plans are also provided to help functions meet the exit criteria.

NOTE

Online versions of the required plans are available as templates from Standards and Methods Control. See the Required Documents section of each chapter for further information for obtaining function specific plan templates. Use the following file specification to copy all of the required plans.

JOKUR::PHASE_REVIEW:*PLANS.SDML
JOKUR::PHASE_REVIEW:*PLANS.TXT

Contact JOKUR::SMC regarding problems copying these files.

This guide is divided into seven chapters, followed by a matrix of Digital design standards to be addressed by phase, a glossary, a list of all referenced documents, and an Index. This guide does not have to be read from beginning to end. It is designed so that the reader can "zero in" on the required information.

Chapter 1 provides a general overview of the Phase Review Process and highlights the major deliverables of each phase.

Chapters 2 through 7 describe responsibilities at a functional level:

- **Chapter 2** Product Management
- **Chapter 3** Marketing
- **Chapter 4** Engineering
- **Chapter 5** Manufacturing
- **Chapter 6** Corporate Product Operations – Sales
- **Chapter 7** Customer Services

The remainder of the guide consists of the following sections:

- **Appendix A** Digital Design Standards by Phase
- **Glossary**
- **Reference Documents**
- **Index**

The following documents provide further information and should be use in conjunction with this guide.

- *EL–ENGRS–OM, Internal Guide to Digital Organizations*
- *The Corporate Product Introduction Guide*
- *EL–00130–00, DEC STD 130–0 Product/System Business Plans: Content Requirements And Format Guidelines*
- *EL–SM498–00, Producing International Products*
- *EL–CP595–00,Corporate Product Introduction Guide*
- *Top 100 Process Overview Manual* (Contact Engineering Product Planning)

ACKNOWLEDGMENTS

Appreciation is expressed for the generous cooperation of individuals who took the time to review this document and provide valuable information for the development of its content.

Though we cite the efforts and generous cooperation of others, Engineering Product Planning takes responsibility for the technical content and integrity of this document.

Chapter 1

CORPORATE PHASE REVIEW PROCESS

1.1 INTRODUCTION

The Phase Review Process provides an operational guideline for managing products throughout their life cycle. It provides a common set of planning, measurement, and implementation tools to help Product Teams deliver quality products to Digital's customers. The process is simple, dynamic, and flexible. It encourages and facilitates effective collaboration among functional groups, and improves the discipline and predictability required for an effective product development and delivery process.

The Phase Review Process defines the life cycle of products over six phases (0 through 5), and provides a set of measurable events for each phase. The process design supports Digital's internal management system. The objectives and deliverables defined for each phase provide appropriate checks and balances throughout the product's life cycle. Deliverables from each phase are evaluated against previously stated objectives prior to gaining approval to proceed to the next phase.

Factors established, confirmed, and documented by the Phase review and approval process are:

- Corporate visibility to products under development
- Fit to Digital's product strategy
- Viable and well integrated Plans
- Sound investment decisions

The Phase Review Process was first implemented by Digital in the mid-1970s to simplify product life cycle management. It organizes work performed in the normal course of doing business and identifies key points in a product's life cycle when management expects to review results prior to making investment commitments. The amount of time spent in each Phase is totally dependent upon the internal processes used to meet the Phase Review requirements. The Phase Review Process itself does not impose time constraints on the users.

Today, as life cycle management becomes more complex, the Phase Review Process is an essential tool for minimizing the uncertainties associated with bringing a product to, or retiring a product from the market. The process is now used throughout the Corporation as the preferred tool for product life cycle management.

Life cycle management within Digital is an ongoing process. As new product concepts are proposed throughout the year, groups sponsoring these proposals ensure their fit with the Corporate Product Strategy. Funding is provided to those proposals that are selected as prospective development activities. It is at this point that groups initiate the use of the Phase Review Process to further explore the proposed product concept. To contain the investment, funding is limited to Phase 0 and Phase 1 activities.

A Product Manager is assigned to the project and a Product Team is formed with members from Marketing, Engineering, Manufacturing, Corporate Product Operations (Sales), and Customers Services. The Product Business Unit (PBU) or sponsoring organization assigns a Finance Manager who provides financial support to the Product Team in the preparation of the Business Plans and other product planning activities,and coordinates Finance activities across all Product Team functions. The Product Team, led by the Product Manager, is responsible for full implementation of the Phase Review Process.

Each member of the Product Team is responsible for soliciting input from their function and communicating project status to their function on an ongoing basis. This enables a proactive approach to life cycle management and allows the Product Team to resolve issues that could negatively impact product introduction or retirement.

1.2 OVERVIEW OF THE PHASE REVIEW PROCESS

The following is an overview of each Phase in the Phase Review process. Each section describes the major objectives of the phase and defines documentation required for that phase and shows the continuous flow of this documentation from phase to phase.

Throughout this chapter, only Phase Exits are described. As time–to–market is critical, many supporting activities may be started in an earlier Phase. Depending on budget requirements, level of risk, and criticality of the FRS date, the Product Team and its management determine whether to begin an activity earlier than the phase in which it is usually begun. Therefore, *Entering Phase N* is not a meaningful concept, except for Phase 0.

1.2.1 Phase 0 – Strategy and Requirements

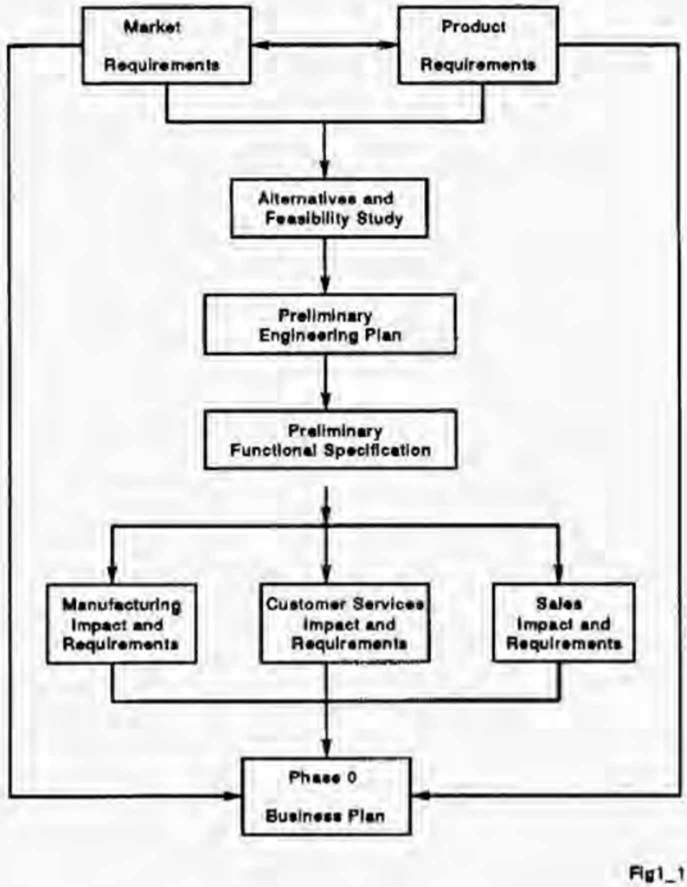
The objective of Phase 0 is to identify to the Corporation a market problem or opportunity and to propose a corresponding product solution that is consistent with Corporate Product Strategy.

The Product Team thoroughly examines customer needs and the impact of the proposed product on corporate resources, and measures these findings against the financial potential of the product proposal. The Product Team then formulates a strategy and defines what is required to develop the concept.

The Product Manager, collaborating with the Product Team, determines the readiness of the product to Exit this and all subsequent Phases. When the Product Team agrees to exit a Phase, public Phase Exit Reviews (internal to Digital) are conducted to communicate the project status to a larger audience.

At Phase 0 Exit, the Product Team is ready to develop plans to support the agreed upon strategy and requirements for the product. Figure 1–1 shows the information generated during Phase 0.

Figure 1–1: Phase 0 – Strategy and Requirements

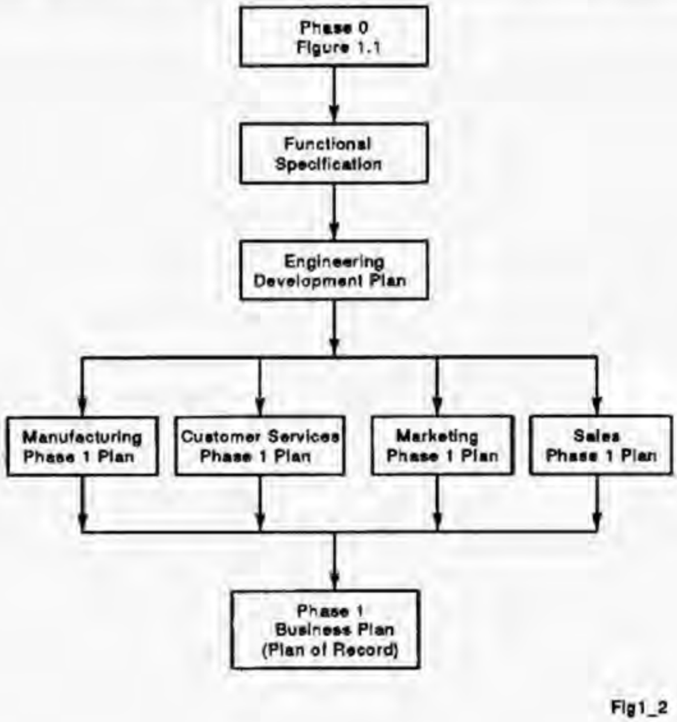


1.2.2 Phase 1 – Planning and Preliminary Design (Business Plan of Record)

The objectives of Phase 1 are to create a functional specification, a preliminary product design, and provide the Corporation with an integrated implementation plan for Phases 2 through 4B. The purpose of the implementation plan is to ensure achievable commitments from all functions involved in the project. The plan must include cross–project interdependencies and a preliminary Product Phase Down Plan.

This is a critical phase for the product because the total investment required to bring the product to market is approved at Phase 1 Exit. The goal of Phase 1 is to eliminate weak ideas while the investment is still relatively contained. The Phase 1 Business Plan is the Plan of Record and is used to measure the product's success in meeting its quality, schedule, function, and revenue goals. Approval of Phase 1 Exit marks Digital's commitment to commercialize the product, and formally authorizes creation of vendor contracts for buyouts. At Phase 1 Exit, the Product Team is ready to implement agreed upon plans. Figure 1–2 shows the information generated during Phase 1.

Figure 1–2: Phase 1 – Planning and Preliminary Design



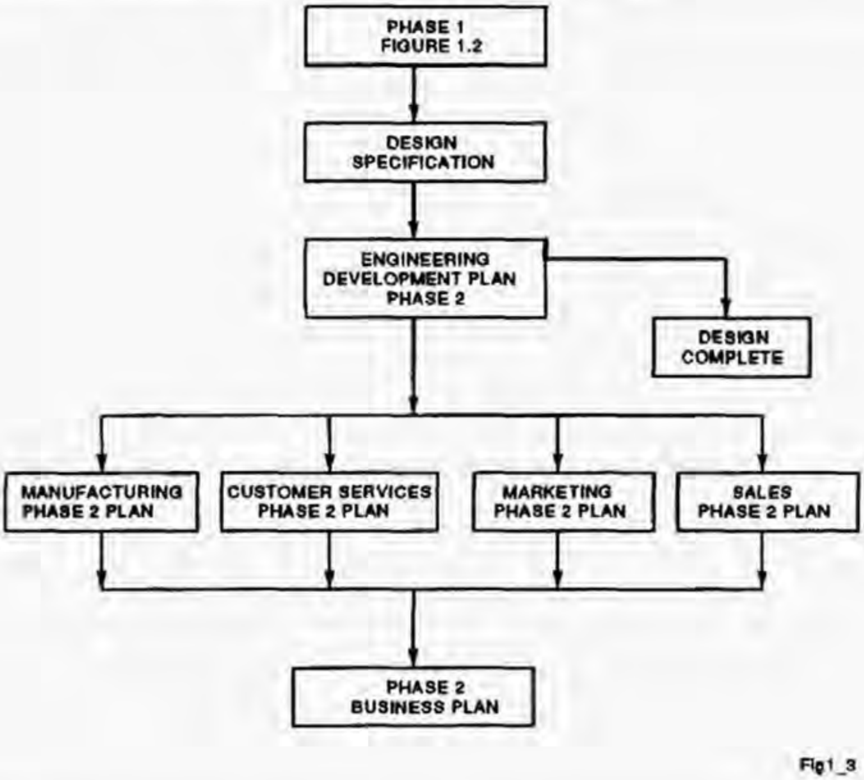
1.2.3 Phase 2 – Implementation and Design

The objective of Phase 2 is to complete the detailed product design and execute the plans committed to at Phase 1 Exit. Phase 2 tends to be the longest phase in the process. During this phase, the design is completed and prototypes are built and verified through internal testing. The goal is to demonstrate that the product has met Phase 0 requirements and Phase 1 and 2 specifications. Full product functionality is tested in at least one configuration representative of the environment into which the product will be sold.

During Phase 2, the Product Manager develops a Product Launch package with Corporate Product Operations (Sales) and ensures that all members of the Product Team have implemented their respective plans.

At Phase 2 Exit, the product design is declared complete and the product becomes a candidate for qualification, pricing, and announcement. Figure 1–3 shows the information generated during Phase 2.

Figure 1–3: Phase 2 - Implementation and Design



1.2.4 Phase 3 – Qualification

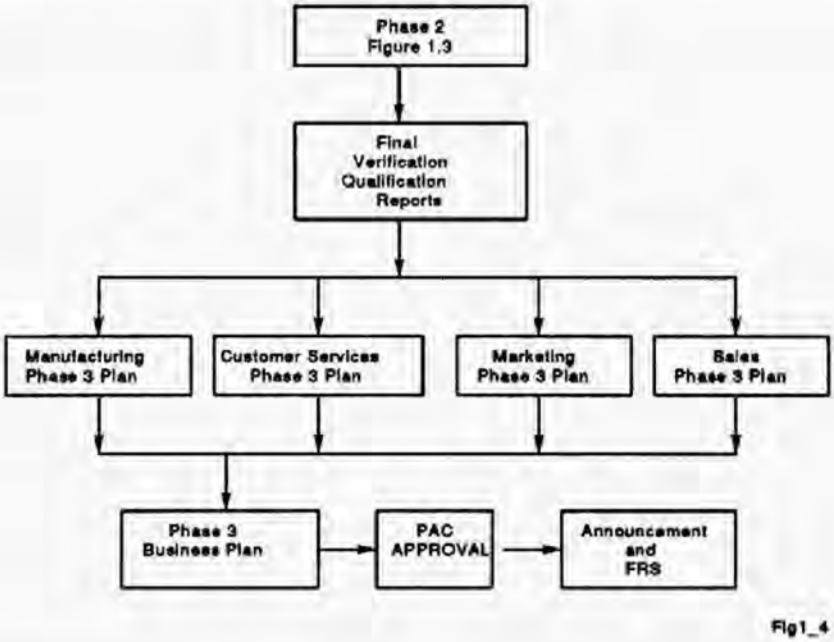
The objective of Phase 3 is to qualify production–level copies of the product, and demonstrate, through internal and external testing and information from field test customers, that the product has met the requirements established in Phase 0 and the specifications established in Phases 1 and 2.

During Phase 3, the Product Team concentrates on completing all announcement and FRS criteria and all internal and external testing. Regulatory approvals are obtained, and training, service, and support functions are in place. The Pricing and Announcement Committee (PAC) verifies that announcement criteria have been met and approves product pricing. The product is announced with inventory available for shipment. All PAC and FRS criteria are completed prior to FRS.

Phase 3 Exit signifies that the product has been announced, orders are being taken, and Manufacturing, Sales, and Services are ramping up to achieve steady–state operation levels.

At the Exit of Phase 3, the Product Team works to ensure a smooth transition from development to steady–state operation. Figure 1–4 shows the information generated during Phase 3.

Figure 1–4: Phase 3 – Qualification



1.2.5 Phase 4 – Production, Sales, and Service

The objective of Phase 4 is to achieve and maintain steady–state volume production, sales, and service, and periodically evaluate the product's performance in the market.

Phase 4 consists of two parts, each having distinct objectives and exit criteria:

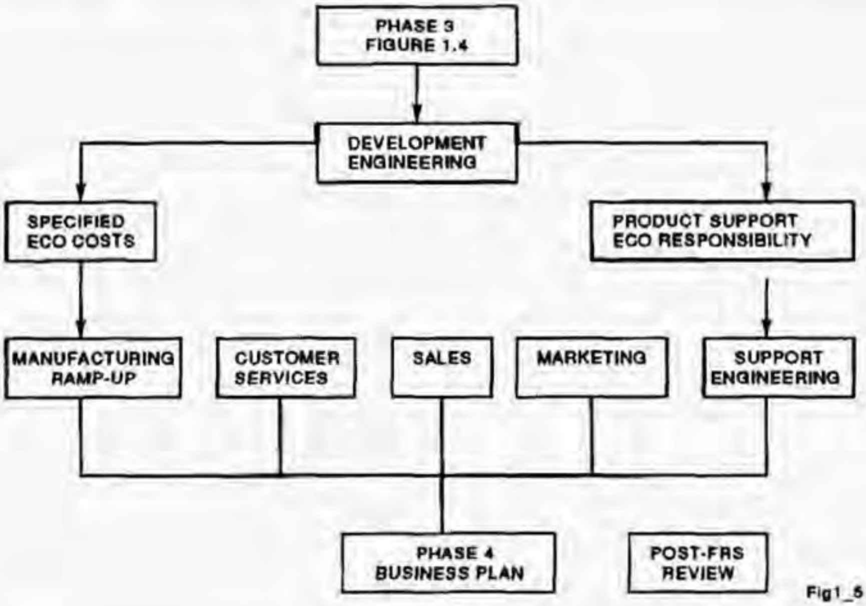
- Phase 4A – Ramp–Up
- Phase 4B – Steady–State Operation

During Phase 4, the focus of the Phase Review Process shifts from development to production, sales, and service. Engineering Change Order (ECO) control and product responsibility is transferred from Development Engineering to Support Engineering. Specified ECO cost responsibility is transferred from Development Engineering to Manufacturing.

Within a month of FRS, the Product Manager convenes the Product Team to conduct a Post–Project Review. The information obtained from this review (generally what could have been improved) is communicated to other project teams to be used as a learning tool for future projects.

Figure 1–5 and Figure 1–6 show the information generated during Phase 4A and Phase 4B.

Figure 1–5: Phase 4A – Ramp–Up

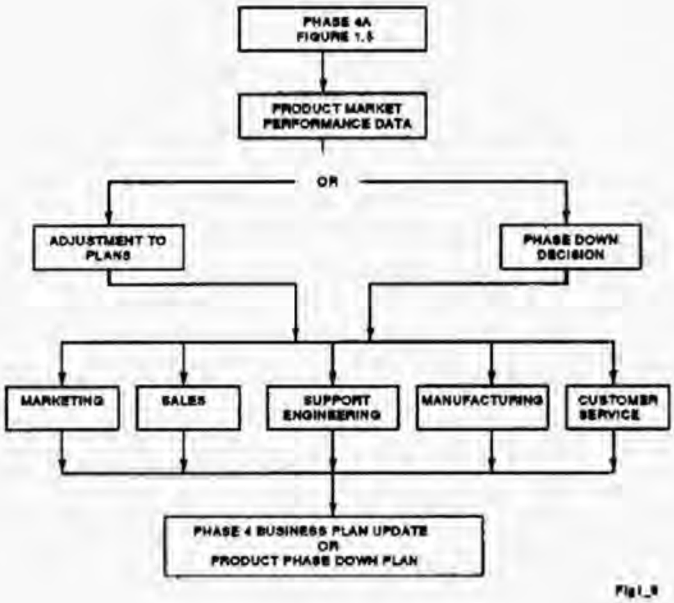


Market performance evaluations are conducted periodically to determine if the planned market, product, and revenue goals are being achieved. The results of these evaluations are used to decide to continue, enhance, or retire the product.

If a decision is made to retire the product, a Product Manager is assigned the responsibility to create and implement a Product Phase Down Plan. A cross-functional team is created to address Manufacturing's last build requirements, the impact of long term contractual agreements, customer migration strategies, continued service requirements, a product phase down schedule, and appropriate Marketing messages.

Approval to Exit Phase 4B signifies Digital's commitment to support the Product Phase Down Plan.

Figure 1–6: Phase 4B Steady-State Operation

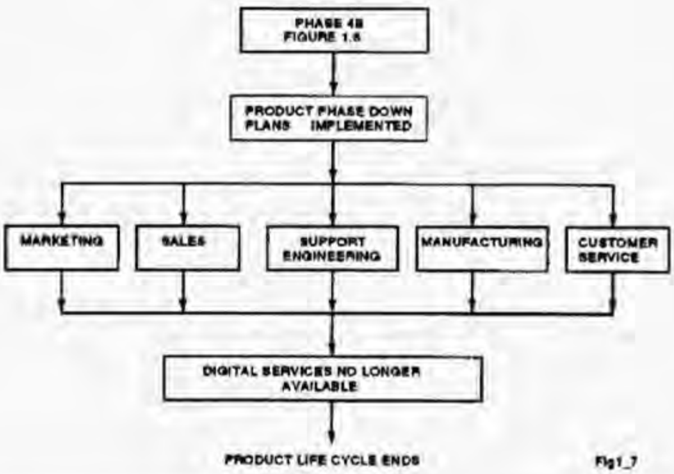


1.2.6 Phase 5 – Product Retirement (Service Continues)

The objective of Phase 5 is to implement the Product Phase Down Plan in a manner that fulfills all of Digital's internal and external commitments.

At times, product retirement assumes the same level of complexity as new product development. The activities of the Product Team members in Phase 5 require the same level of cross–functional communication and collaboration that was required during the planning and development phases of the product. Figure 1–7 shows the information generated during Phase 5.

Figure 1–7: Phase 5 - Product Retirement (Service Continues)



Although manufacturing has ceased, and the product is no longer sold, Digital will continue to service the product throughout the remainder of its useful service life. The life cycle of the product ends when Digital no longer provides service for the product.

Chapter 2

PRODUCT MANAGEMENT

2.1 PURPOSE

The Product Management function within Digital uses the Phase Review Process as a tool to:

- Manage products and systems throughout their life cycle.
- Provide a framework for the consistent, high quality product proposals that support the Digital Corporate Product Strategy and are congruent with the management review process.
- Drive worldwide coordination and integration of key internal organizations such as Marketing, Sales, Finance, Law, Engineering, Manufacturing, and Customer Services through the product's life cycle.

2.2 FUNCTIONAL RESPONSIBILITIES

Product Management is responsible for proposing a product solution that fulfills identified international market needs, fits within the Corporate Product Strategy, and is a sound business investment for the Corporation.

During the product's life cycle major issues and business decisions will require functional expertise. The Product Manager should include functional support representatives in the Product Team discussions concerning these issues from such groups as Finance, Component Engineering, Architecture, Qualification, and Quality groups.

To satisfy the above responsibilities, Product Management will:

- Establish and lead the Product Team through the Phase Review Process.
- Function as the primary source and focal point of all Product information for key internal groups such as Marketing, Sales (Corporate Product Operations), Engineering, Finance, Manufacturing, and Customer Services.
- Create and obtain approval for Phase 0 through 5 Business Plans. Refer to *DEC STD 130–0 Product/System Business Plans: Content Requirements and Format Guidelines* for additional information.
- Coordinate key functional inputs that reflect the appropriate Corporate commitment to bring the product to market.
- If Corporate Product Operations (Sales) has determined that it need not be directly involved as a member of the Product Team, the Product Manager and the Marketing member of the Product Team shall coordinate completion of all announcement and sales related activities and Exit Criteria following the Product Announcement Committee (PAC) process. For further information refer to Chapter 6 Sales and the following documents:
  - — PAC Manual (EL–CPPAC–00, *Pricing and Announcement Committee Corporate Policies for Product Pricing, Announcement and first Customer Ship*
  - — *EL–CP595–00, Corporate Product Introduction Guide*

- Present the program, product strategy, and future directions to selected customers and third–party vendors through the Proprietary Information Disclosure (PID) process.
- Ensure that product information is available to the field for forecasting and planning purposes, such as *The Product Business Unit/Product Marketing Group Volume Planning Guide* (Blue Book).
- Present the key product proposals to management and corporate committees.
- Ensure that the product is properly represented at each stage of the review and approval process.
- Ensure that all aspects of the Phase Review Process are executed for the product development effort. Refer to *DEC STD 028–0 Phase Review Policy*.
- Ensure that intellectual property rights in innovative product developments are protected.
- Coordinate Trademark strategy.

2.3 PRODUCT MANAGER'S ACTIVITIES AND DELIVERABLES

The Product Manager shall ensure the completion of the activities and documents required by the Phase Review Process as shown in Figure 2–1.

Figure 2–1: Product Manager's Activities and Deliverables

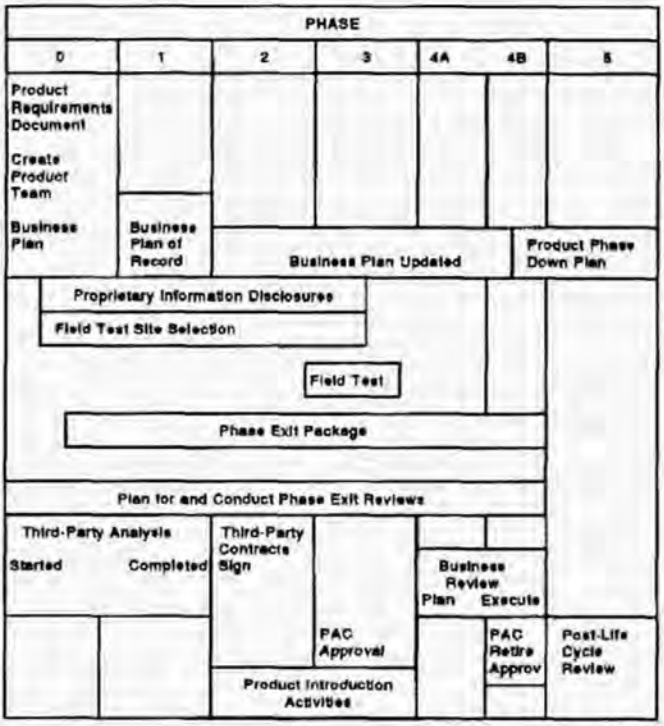


Fig2_1

2.4 EXECUTING AND EXITING EACH PHASE

Each phase in the product's life cycle provides a mechanism for the systematic review of proposals, plans, and results in a manner that allows for controlled funding, resource allocation, and project approval.

Questions that serve as Memory Joggers have been provided for the Product Manager. These questions are not all–encompassing and should be used only when applicable. Their purpose is to stimulate the thought process and surface issues as early as possible in each phase.

Additional Exit Criteria may be added or modified by the Product Team, when appropriate, at each phase.

The Product Manager is responsible for orchestrating the activities of the Product Team to move the product through the Phase Review Process.

The Product Manager is also responsible for such activities as writing and updating the Business Plan.

2.4.1 Phase 0 – Strategy and Requirements

Objective: Define product requirements in response to market requirements, and develop a Business Plan to support Corporate revenue, growth, and profit goals.

2.4.1.1 Phase 0 Exit Criteria

Product Team, representing the Corporation worldwide, established, consisting of members from Marketing, Engineering, Product Management, Manufacturing, Sales, and Customer Services, with support from Finance.

The protection of intellectual property rights used in the product coordinated through the Engineering Law Group.

The Internationalization Plan for the product is available from the International Engineering Development Group (IED). See Glossary for Internationalization Plan definitions. IED contact is Jim Mills. See ELF.

The GIA Product Strategy Committee contacted for Asian Base Development Plans. (Contact is Les Dole. See ELF.)

Product Requirements Document written, reviewed, approved, and published.

Preliminary phase exit schedule developed.

Third–party analysis for buyout begun.

All individuals responsible for Phase exit approval identified in the Business Plan.

Phase 0 Business Plan written, reviewed, approved, and published. Refer to *DEC STD 130–0 Product/System Business Plans: Content Requirements and Format Guidelines* for more information.

Export requirements identified by the Corporate Export and Trade Group (CE/T), Washington D.C.

NOTE

> To ensure a timely review, provide CE/T with a summary product description, an overview of the target markets, estimated month of announcement, and initial date feedback is required. (Export contact is Don Ames. See ELF.)

Product fits Corporate and PBU or sponsoring organization strategies as defined in the Long Range Plans (LRP).

The protection of intellectual property rights in the product has been coordinated through the Engineering Law Group.

Phase Exit Criteria for Marketing, Sales, Engineering, Manufacturing, and Customer Services completed.

A Phase 0 Exit Review held with all appropriate persons attending and all open issues resolved.

All members of the Product Team in agreement to exit Phase 0.

All known risks and major dependencies documented by the Product Team.

Approved Phase 0 Exit plans submitted to the PBU or sponsoring organization for archiving. Copies of these plans submitted to Engineering Product Planning, for Top 100 Products.

Phase 0 Exit Package, as defined by the Phase Review Committee (PRC), submitted to the Phase Review Committee for Top 100 Products. Refer to *Top 100 Process Overview Manual.* Contact Carlha Vickers, Engineering Product Planning.

Appropriate approvals, as documented in the Business Plan at the Phase 0 Exit, obtained to exit Phase 0.

2.4.1.2 Phase 0 Activities

Identify the members of the Product Team.

Define product goals and strategy.

Ensure that identified internationalization requirements have been addressed by members of the Product Team in their Phase 0 Plans.

Ensure that the product will be designed to be competitive in all countries designated as strategic markets for the corporation. Refer to *DEC STD 066–3 Policy for Designing Products for All Countries Designated as Strategic Markets.*

Identify the key factors critical to the success of the product including technology, architecture, profit, resources, schedule. Quantify the impact of these key factors.

Ensure that the Product Team reviews the Phase 0 Exit Criteria for applicability.

Translate Marketing's definition of market requirements into the Product Requirements Document.

Ensure that the impact and requirements from other functions, such as worldwide Manufacturing, Marketing, Customer Services, and Sales, have been addressed in the Product Requirements Document and Business Plan.

Integrate product requirements identified by IED in the Internationalization Plan into the Phase 0 Business Plan and Product Requirements document.

Ensure that the Engineering Law Group or appropriate Patent Engineer has been contacted to establish and implement an applicable legal protection strategy for the product.

Ensure that prior to any proprietary information discussions, the Proprietary Information Disclosure (PID) process has been followed and intellectual property protection strategies are being implemented.

Contact the Corporate Export and Trade Group (CE/T), Washington, D.C. to determine export requirements. This applies to hardware and software products developed worldwide, technical data, and Proprietary Information Disclosures throughout the life of the product.

Understand sales support requirements and responsibilities for low volume products that are not directly supported by Sales.

Collect and distribute the following Assumptions Package to the Product Team:

- Market requirements from the Marketing Plan
- First pass product requirements that include product descriptions (functional requirements should be provided as soon as available)
- Alternatives and Feasibility Study
- Assumptions:
    - Volume projections
    - Announcement and target First Revenue Ship (FRS) dates
    - Major goals (such as time–to–market, cost, and availability)

Update the Product Team on product status. Initiate discussions on the type of announcement activities the product merits.

For Strategic Marketing Products (see Chapter 3 Marketing), ensure that the Marketing Advisory Board (MAB) Team and the European Systems Strategy Planning Group, and the GIA Product Strategy Committee has received review copies of the Business, Marketing, and Sales Plans at least two weeks prior to the scheduled phase exit. (Contact Marc Zavadil, Strategic Systems Planning Group, Europe and Les Dole, GIA Product Strategy Committee. See ELF for contact information.)

Announce the phase exit review date and make available all phase exit documents no later than two weeks prior to the scheduled review date.

Conduct a Phase 0 exit review.

Ensure that the appropriate approvals have been obtained to exit Phase 0.

2.4.1.3 Phase 0 Memory Joggers

Has the Product Team agreed to the product goals stated in the Business Plan?

Has the Law Department been contacted to approve the product name or trademark strategy for the product? Are any patent, copyrights, or other intellectual property rights infringements involved?

Has there been adequate consideration of the process for obtaining patent protection for the product, product components, or production method? Of the process for defining trade secrets requiring protection?

Has International Engineering Development (IED) been contacted? Is an Internationalization Plan in place?

Are all major milestones of component product schedules integrated into a single master project schedule?

2.4.2 Phase 1 – Planning and Preliminary Design

Objectives: Create an integrated plan and schedule; ensure development of engineering product specifications and a complete product justification to support the proposed investment.

2.4.2.1 Phase 1 Exit Criteria

Legal Protection Strategy in place, including updates to the Phase 0 Strategy, prior to any Proprietary Information Disclosures (PIDs).

Export requirements identified.

NOTE

> To ensure a timely review, provide CE/T with a summary product description, an overview of the target markets, the estimated month of announcement, and the date feedback is required. (Export contact is Don Ames. See ELF for contact information.)

Agreement and commitment by each Product Team member to the Business Plan of Record, Product Functional Specification, Internationalization Plan (I18N Plan) and product's schedule.

Third–party analysis for buyouts completed. (No contract signed until Phase 1 Exit approval.)

Volume projections specified in the Business Plan aligned with projections from worldwide Sales, Manufacturing, and Product Marketing Groups (PMG).

Assumptions and requirements evaluated since the Phase 0 exit and significant changes communicated to the Product Team and appropriate approval bodies.

Phase Exit Criteria for Marketing, Sales, Engineering, Manufacturing, and Customer Services completed.

Business Plan (Plan of Record) updated, reviewed, approved, and published. Refer to *DEC STD 130–0 Product/System Business Plans: Content Requirements and Format Guidelines.*

Phase 1 Exit Review held with all appropriate persons attending and all open issues resolved.

All members of the Product Team in agreement to exit Phase 1.

All known risks and major dependencies documented by the Product Team.

Phase 1 Exit Package, as defined by the Phase Review Committee (PRC), submitted to the Phase Review Committee for Top 100 Products. Refer to *Top 100 Process Overview Manual.* Contact Carlha Vickers, Engineering Product Planning.

Approved Phase 1 Exit plans submitted to the PBU or sponsoring organization for archiving. Copies of these plans submitted to Engineering Product Planning, for Top 100 Products.

Appropriate approvals obtained to exit Phase 1 (as documented in the Business Plan at the Phase 1 Exit).

2.4.2.2 Phase 1 Activities

Ensure that the required staffing to develop and deliver the product is available and committed.

Evaluate assumptions and requirements since the Phase 0 Exit. Update affected plans as necessary and communicate significant changes to the appropriate review and approval bodies.

Ensure that the Product Team reviews the applicability of Phase 1 Exit Criteria.

Ensure that any open issues or action items generated at Phase 0 are resolved to the satisfaction of the Product Team.

Request New Products Form (NPF) from release engineering for software products.

Ensure that the Product Functional Specification addresses requirements identified in Phase 0. Identify and document any exceptions as an addendum to the Product Requirements and Business Plans.

Contact the Engineering Law Group to establish and update if necessary, applicable Legal Protection Strategy for the product.

Contact the Corporate Export and Trade Group (CE/T), Washington, D.C., to determine export license requirements. This applies to hardware and software products developed worldwide throughout the life of the product.

Solicit potential Field Test sites from the Product Team and review this list with Corporate Product Operations to eliminate possible problem sites.

Identify primary factors that ensure the success of this product and quantify their impact (such as, assumptions, customer dependencies, economic and environmental issues, materials, new processes, services, and technology).

Obtain cross-functional commitments and support from worldwide Engineering, Finance, Marketing, Sales, Manufacturing, and Services.

Ensure that the Proprietary Information Disclosure is developed and approved as defined in *Corporate Proprietary Information Disclosure Policies Procedures* (order number EJ-3198305) that may be obtained from Printing and Circulation Services in Northboro.

Ensure that the product is still compatible with Corporate Product Strategies.

Consult with worldwide Sales, Industry Marketing, and PMGs regarding Phase 1 pricing volume projections.

Ensure that plans are in place to satisfy the critical international requirements for the product. Finalize Internationalization Plan. Refer to subheading 2.5 Required Product Management Documents.

Ensure that the product and its goals (including quality and performance) have specific, well defined metrics.

Ensure that plans are in place for meeting all standards and regulatory requirements and obtaining agency approvals worldwide. Refer to *DEC STD 060-0 Design and Certification of Hardware Products to National and International Regulations and Standards – Policy and Procedures* for more information.

For Strategic Marketing Products (see Chapter 3 Marketing), ensure that the MAB Team and the European Systems Strategy Planning Group, and the GIA Product Strategy Committee has received review copies of the Business, Marketing, and Sales Plans at least two weeks prior to the scheduled phase exit. (Contact Marc Zavadil, Strategic Systems Planning Group, Europe and Les Dole, GIA Product Strategy Committee. See ELF for contact information.)

Update the Product Team on product status.

For hardware products only, provide the Engineering Manager with input to the part number family assignment plan.

Collect, from the Product Team, the number of units required to support Phase 2 and Phase 3 activities (such as internal test, training, Field Test, introduction activities, applications and characterization).

Generate a preliminary plan for the build, distribution, and financing of pre-FRS units.

Ensure that reviews with appropriate New Product Committees are conducted prior to Phase 1 Exit, including the VAX New Product Committee (VNPC), Networks New Products Committee (NNPC), and Micros New Product Committee (MNPC).

Identify which critical events must occur for the product to meet its schedule.

Ensure that any open issues or action items generated at Phase 0 are resolved to the satisfaction of the Product Team.

Announce the Phase exit review date and make available all phase exit documents no later than two weeks prior to the scheduled review date.

Prior to the Phase 1 Exit Review Meeting, ensure that all members of the Product Team are in agreement to exit Phase 1.

Conduct the Phase 1 exit meeting.

2.4.2.3 Phase 1 Memory Joggers

Is this product a good investment for Digital?

Does the integrated schedule contain:

- Activities during the following phases of a product's life cycle: prototype, development, preproduction, and phase down?
- Tasks and interdependencies of all worldwide functional groups?

Are there conflicts with other hardware or software products? Is this product in direct competition with another Digital internal product?

What agreements have been made with other groups to ensure the product's success? Have the agreements been documented? For example, is a final Internationalization Plan from International Engineering Development (IED) in place?

Has the Product Manager read the following product introduction manuals?

- Pricing and Announcement Committee's (PAC) manual, EL-CPPAC-00, *Corporate Policies for Product Pricing, Announcement, and First Customer Ship*.
- *EL-CP595-00, Corporate Product Introduction Guide.*

Has a plausible product cost estimate been developed including manufacturing labor and overhead costs? Refer to *DEC STD 130-0 Product/System Business Plans: Content Requirements and Format Guidelines* for more information.

Are there new ideas developed for which intellectual property rights strategies need to be implemented?

2.4.3 Phase 2 – Design and Implementation

Objectives: Execute the plans committed to in Phase 1 and deliver the proposed product with stated characteristics, on time, within budget, and at cost.

2.4.3.1 Phase 2 Exit Criteria

Assumptions and requirements evaluated since the Phase 1 Exit and significant changes communicated to the Product Team and appropriate approval bodies.

A legal protection strategy is in place, including updates to the Phase 1 strategy, prior to any new Proprietary Information Disclosures (PIDs).

The Corporate Export and Trade Group (CE/T) has determined the appropriate government classification, under the current export regulations, and advised the Product Manager of the conditions under which the product may be exported.

Third–party contracts signed.

Field Test Sites selected, licensed, and prepared to begin testing.

Customer field test support in place.

Field Test Plan written, reviewed, approved, and published.

Product ready for qualification as specified in Field Test Plan.

The volume projections specified in the Business Plan aligned with projections from worldwide Sales, Manufacturing, and the PMGs, For Top 100 Products.

Total worldwide product volume requirements for qualification, characterization, product introduction, and first quarter ramp identified and agreed to by the Product Team.

Activities required to support Product Introduction defined.

Phase Exit Criteria for Marketing, Sales, Engineering, Manufacturing, and Customer Services completed.

Phase 2 Business Plan updated, reviewed, approved, and published. Refer to *DEC STD 130–0 Product/System Business Plans: Content Requirements and Format Guidelines* for more information.

A Phase 2 Exit Review held with all appropriate persons attending and all open issues resolved.

All members of the Product Team in agreement to exit Phase 2.

All known risks and major dependencies documented by the Product Team.

Phase 2 Exit Package, as defined by the Phase Review Committee (PRC), submitted to the Phase Review Committee for Top 100 Products. Refer to *Top 100 Process Overview Manual*. Contact Carlha Vickers, Engineering Product Planning.

Approved Phase 2 Exit plans submitted to the PBU or sponsoring organization for archiving. Copies of these plans submitted to Engineering Product Planning, for Top 100 Products.

Appropriate approvals obtained to exit Phase 2 (as documented in the Business Plan).

2.4.3.2 Phase 2 Activities

For software products, ensure that the New Products Form (NPF) is updated by release engineering to reflect documentation and media kits.

Ensure that a Legal Protection Strategy is in place, and export requirements are satisfied prior to any PIDs.

Ensure that the PID is developed and approved as defined in the Corporate Proprietary Information Disclosure Policy.

Negotiate agreement with Sales and Marketing regarding determination of proposed Field Test Sites, and deliver the list to Engineering for inclusion in the Field Test Plan.

Ensure that the preliminary Software Product Description (SPD) is written and reviewed for Field Test.

Ensure that progress against the integrated schedule is monitored on a regular basis.

Match unit requests to support Phase 2 and Phase 3 activity with Manufacturing capacity. Work prioritization and allocation of available units with Product Team.

Ensure that there is a Product Introduction Information Package to support Introduction activities, if required by Corporate Product Operations (Sales).

NOTE

The Product Introduction Information Package may include a description of hardware and software support requirements, prerequisite equipment, site planning information, estimated equipment costs, and configurations. This information is used to plan for customer seed units, Field Service training units, geography support centers, demos, Application Centers for Technology (ACTs), Digital Competence Centers (DCC), application characterization, and the field benchmark center. This Product Introduction Information Package must be distributed to Marketing, Sales, Services, Manufacturing, Engineering, and the Law Group.

Work with the Product Team to prepare for product qualification and Introduction.

Update the plan for pre–FRS units with the Product Team.

Review and begin Announcement and FRS checklists. Refer to *PAC Manual.*

Ensure that the Product Team agrees that all the Phase 2 Exit Criteria have been met.

For hardware and systems products, ensure that valid part numbers have been obtained from the Chief Engineer's Office for the total product offering. Refer to *DEC STD 012–2 Unified Numbering Code for Part Identifier Class Codes and Related Document Identifiers.* For software products refer to *DEC STD 012–4 Unified Numbering Code (UNC) – Software Numbering Conventions.*

Review product documentation.

Ensure the completion of plans for prototype distribution, including customer Field Test Sites.

Ensure that all documentation, Product Team plans, and the Business Plan have been updated to reflect changes made to the product or program.

For Strategic Marketing Products (see Chapter 3 Marketing), ensure that the Marketing Advisory Board (MAB) Team and the European Systems Strategy Planning Group has received review copies of the Business, Marketing, and Sales Plans at least two weeks prior to the scheduled phase exit. (Contact Marc Zavadil, Strategic Systems Planning Group, Europe. See ELF.)

2.4.3.3 Phase 2 Memory Joggers

Has the product schedule been updated on a regular basis? Has the Product Team been notified of any deviations from the schedule? Are functional groups meeting their obligations?

Has Services confirmed that support people have been trained and provided with a sufficient number of spares and documentation to support field test plans?

Has the Government Systems Group been notified in advance when developing pricing and packaging?

Has Customer Services Systems Engineering (CSSE) Project Management submitted service pricing for Field Services Pricing and Policies Committee (FSPPC) approval?

Are there any new ideas developed for which intellectual property rights strategies need to be implemented?

2.4.4 Phase 3 – Qualification

Objectives: Demonstrate that the product meets its stated specifications through internal and external testing, and complete all required Announcement and FRS criteria.

2.4.4.1 Phase 3 Exit Criteria

Assumptions and requirements evaluated since Phase 2 Exit and significant changes communicated to the Product Team and appropriate approval bodies.

Legal Protection Strategy in place, including updates to the Phase 2 strategy, and export requirements satisfied prior to any new Proprietary Information Disclosures (PIDs).

All announcement and First Revenue Ship (FRS) criteria met.

Final Software Product Description (SPD) written, reviewed, approved, and published.

Final New Product Form (NPF) reviewed and approved.

All pricing actions approved by the Pricing and Announcement Committee (PAC) and the Marketing Sales and Strategy Committee (MSSC), if applicable.

The volume projections in the Business Plan are aligned with projections from Sales, Manufacturing, Industry Marketing, and PMGs.

Demonstrate, through documentation of test results, that the product meets performance goals.

Plans in place, if appropriate, for transition of Product Management responsibility for remainder of the product's life cycle.

Phase 3 Business Plan updated, reviewed, approved, and published. Refer to *DEC STD 130–0 Product/System Business Plans: Content Requirements and Format Guidelines* for more information.

Phase Exit Criteria for Marketing, Sales, Engineering, Manufacturing, and Customer Services completed.

A Phase 3 Exit Review held with all appropriate persons attending and all open issues resolved.

All members of the Product Team in agreement to exit Phase 3.

All known risks and major dependencies documented by the Product Team.

For Top 100 Products, Phase 3 Exit Package as defined by the Phase Review Committee (PRC), submitted to the Phase Review Committee. Refer to *Top 100 Process Overview Manual.* Contact Carlha Vickers.

Approved Phase 3 Exit plans submitted to the PBU or sponsoring organization for archiving. Copies of these plans submitted to Engineering Product Planning, for Top 100 Products.

The appropriate approvals obtained to exit Phase 3 (as documented in the Business Plan).

2.4.4.2 Phase 3 Activities

Evaluate assumptions and requirements since the Phase 2 Exit. Update affected plans as necessary and communicate significant changes to the appropriate review and approval bodies.

Obtain approval to FRS the product.

Ensure that the PID is updated and approved as defined in *Corporate Proprietary Information Disclosure Policy.*

Contact the Engineering Law Group to establish and update, if necessary, the applicable legal protection strategy for the product. Include, in particular, that strategy relating to product naming and trademarks.

Ensure that regulatory approvals have been obtained worldwide.

Ensure that Field Test and Introduction requirements are complete. Refer to the *PAC Manual* for more information.

Monitor the Product Team's integrated schedule of activities on a regular basis.

Ensure the delivery of all Field Test materials to selected sites.

For VMS layered products, submit Product Authorization Key (PAK) to product registrar in Software Quality Management (SQM).

Update Product Team on product status to help determine the type of announcement activities the product merits.

Sales Update and Competitive Update Article(s) written, approved, and submitted.

Complete Announcement and FRS criteria for approval committees. Refer to *Refer to the PAC Manual* for more information.

Ensure that Maynard List Price (MLP) forms have been prepared to place related older products in the Maintenance Only section of the Corporate Price File.

For software, ensure Software Distribution Center (SDC) New Products Form (NPF) has been approved by the Product Manager.

Prepare, approve, and submit MLP forms to Data Management Services to enter, update, and delete information contained in the hardware, software, packaged systems, and Maintenance Only sections of the Corporate Price File, Digital Standard Price List, and its Addenda. Make changes to the Option Module List.

Write in PAC proposal form all pricing actions, such as pricing of hardware and software licenses, price changes, special sales, discount changes, First Revenue Ship (FRS) criteria, and product features/presentations. Obtain approval from the PBU or sponsoring organization and the Pricing and Announcement Committee (PAC) before announcement to the field and customers.

Obtain Marketing and Sales Strategy Committee (MSSC) approval when required.

Ensure that Field Test Sites are supported, polled on the results according to plan, and that appropriate field test feedback has been implemented.

Ensure that there has been an assessment of the effect of the product's announcement on other Digital products. This is typically part of the Business Plan (See DEC STD 130–0).

Ensure that the Law Department reviews PAC/MSSC proposals and Marketing communications materials.

Ensure the successful completion of internal qualification against product specifications, Digital standards, and industry standards prior to FRS.

Ensure completion of external country–specific testing.

For hardware and systems products only, ensure that the Chief Engineer's Office has been notified and has approved any part number deviations from those approved at Phase 2 Exit.

Ensure that all testing has been completed, and product performance data is published.

Ensure the availability of Application and Performance information for Sales Literature.

Ensure that customers have been identified for the first hardware production units.

Schedule a Post–FRS Review within a month of FRS. This review is to allow the Product Team to evaluate the effectiveness of the tools and processes used to develop and introduce the product.

Prior to the Phase 3 Exit Review meeting, ensure that the Product Team agrees that all Phase 3 Exit Criteria have been met.

Conduct final reviews prior to FRS with the appropriate New Product committees, such as the VAX New Products Committee (VNPC), Micros New Products Committee (MNPC), Networks New Products Committee (NNPC), and Software Quality Management (SQM).

Resolve any open issues or action items generated at Phase 2 to the satisfaction of the Product Team.

For Strategic Marketing Products (see Chapter 3), ensure that the MAB Team has received review copies of the Business, Marketing, and Sales Plans no less than two weeks prior to the scheduled phase exit.

2.4.4.3 Phase 3 Memory Joggers

What are the critical events and developments that must occur within other internal and external groups?

For hardware products, have appropriate changes been made to the Option Module List?

Has the Law Department reviewed promotional material?

Are plans in place for the transition of the product to Support Engineering or Maintenance Engineering?

Are there any new ideas developed for which intellectual property rights strategies need to be implemented before product announcement?

2.4.5 Phase 4A – Ramp–Up

Objective: Evaluate product demand and supply and take appropriate action.

2.4.5.1 Phase 4A Exit Criteria

Assumptions and requirements evaluated since the Phase 3 Exit and significant changes communicated to the Product Team and appropriate approval bodies.

The product is meeting its Sales, Services, Manufacturing, and Marketing goals.

The volumes specified in the Business Plan are aligned with projections from Sales, Manufacturing, and the PMGs, for Top 100 Products.

A Product Manager is available for continuing management of the Product Team.

Plans are in place for Product's Business Performance Reviews (to be held annually, at a minimum).

A Post–FRS Review meeting held to allow the Product Team to evaluate the effectiveness of the tools and process used to develop and introduce the product.

Phase 4 Business Plan updated, reviewed, approved, and published. Refer to *DEC STD 130–0 Product/System Business Plans: Content Requirements and Format Guidelines* for more information.

Phase Exit Criteria for Marketing, Sales, Engineering, Manufacturing, and Customer Services completed.

A Phase 4A Exit Review held with all appropriate persons attending and all open issues resolved.

All members of the Product Team in agreement to exit Phase 4A.

All known risks and major dependencies documented by the Product Team.

Approved Phase 4A Exit plans submitted to the PBU or sponsoring organization for archiving. Copies of these plans submitted to Engineering Product Planning, for Top 100 Products.

Appropriate approvals obtained to exit Phase 4A (as documented in the Business Plan at the Phase 0 Exit).

2.4.5.2 Phase 4A Activities

Evaluate assumptions since the Phase 3 Exit. If no longer valid, reevaluate and update the functional and business plans. Communicate changes to the Product Team and appropriate approval bodies.

Evaluate product performance feedback from Quality, Manufacturing, Services, Marketing, and Sales, and take appropriate action.

Ensure that the Product Introduction is working smoothly. If not, coordinate Introduction with Sales.

Participate in defining any follow-on products to be developed.

Ensure that the Chief Engineer's Office has been notified of planned or potential part number changes to a hardware product as a result of:

- ECOs
- Value Engineering activity
- Product Enhancements or mid–life kickers
- Other activities that may require changing or adding part numbers to the current product offering

Once shipment has been achieved, periodically conduct Business Performance Reviews of the product forecast versus actual sales and other financial objectives. Update the Business Plan as required. Refer to *DEC STD 130–0 Product/System Business Plans: Content Requirements and Format Guidelines* for more information.

Ensure that ongoing service and support plans and resources are in place.

If contemplating changes to the Price Book, take into account any affected products' worldwide sales.

Resolve any open issues or action items generated at Phase 3 exit to the satisfaction of the Product Team.

For Strategic Marketing Products (see Chapter 3), ensure that the MAB Team has received review copies of Business, Marketing, and Sales Plans no less than two weeks prior to the scheduled phase exit.

2.4.5.3 Phase 4A Memory Joggers

Is the profitability of the product less than planned or less than the corporate average for like products? Define what action will be taken.

If repricing a product, has a PAC proposal been written and approved?

Have worldwide implications of repricing been considered and addressed?

Have all actions, such as pricing of hardware and software licenses, special sales, and discount changes, been written in PAC proposal form and approved by the PBU or sponsoring organization and then by the PAC before announcement to the field and customers?

2.4.6 Phase 4B – Steady–State Operation

Objectives: Monitor Sales, Service, Support Engineering, and Manufacturing activities. Evaluate results against plans and orchestrate change as necessary.

2.4.6.1 Phase 4B Exit Criteria

Assumptions and requirements evaluated since the Phase 4A Exit and significant changes communicated to the Product Team and appropriate approval bodies.

Plans that support the retirement of the product in place for each functional group.

Product Phase Down Team established.

Product Phase Down Plan written, reviewed, approved, and published.

All worldwide Phase Down issues addressed.

PRC approval received prior to submitting to PAC.

Phase Down proposal approved by PAC.

Phase Exit Criteria for Marketing, Sales, Engineering, Manufacturing, and Customer Services completed.

Phase 4B Exit Review held with all appropriate persons attending and all worldwide phase down issues resolved.

All members of the Product Phase Down Team in agreement to exit Phase 4B.

All known risks and major dependencies documented by the Product Phase Down Team.

Phase 4B Exit Package, as defined by the Phase Review Committee (PRC), submitted to the Phase Review Committee for Top 100 Products, Refer to *Top 100 Process Overview Manual.* Contact Carlha Vickers, Engineering Product Planning.

Approved Phase 4B Exit plans submitted to the PBU or sponsoring organization for archiving. Copies of these plans submitted to Engineering Product Planning, for Top 100 Products.

Appropriate approvals obtained to exit Phase 4B (as documented in the Business Plan at the Phase 0 Exit).

2.4.6.2 Phase 4B Activities

Evaluate product performance feedback from Quality, Manufacturing, Services, Marketing, and Sales, and take appropriate action.

Participate in definition of any follow–on products.

Conduct Business Performance Reviews to determine one of the following courses of action:

- Take no action, and continue as planned
- Enhance the product (mid–life kicker)
- Introduce new marketing programs
- Value Engineer (VE)the product
- Phase Down and Retire the product

Ensure that the Chief Engineer's Office has been notified of planned or potential part number changes to a hardware product as a result of:

- ECOs
- Value Engineering activity
- Product Enhancements or mid–life kickers
- Other activities that may require changing or adding part numbers to the current product offering

Establish a Product Phase Down Team with representatives from appropri–ate functional groups, including Support Engineering, Customer Services, Manufacturing, Sales, and Marketing.

Incorporate guidelines from the *Product Phase Down Handbook for Product Managers* into the Product Phase Down Plan. (Order number EZ–J360887, Northboro, Ma.)

Ensure that all worldwide issues concerning product phase down have been addressed in the Product Phase Down Plan, including:

- Manufacturing's last build
- Long–term contractual agreements
- The customer migration strategy
- Continuing service–life requirements and plans
- Development of the marketing messages
- Product phase down schedule

Ensure that all pricing actions have been written in PAC proposal form, approved by the PBU or sponsoring organization, and approved by PAC before announce–ment to the field and customers. (This includes the pricing of hardware and software licenses, price changes, special sales, discount changes, and phase down announcement criteria, such as pricing, availability, and support provisions.)

2.4.6.3 Phase 4B Memory Joggers

Have the financial objectives of the product been met?

What products are available to replace this product?

How good are the alternative product opportunities?

Have economic or marketing factors been an element of the decision to phase down the product?

Have manufacturing and field service agreed to ongoing logistical support for the product?

Has product modification been explored relative to prolonging the market life of this product?

Has the Product Phase Down Plan been written with input from functional group representatives?

Has a phase down schedule been prepared for the product? Does it contain tasks and interdependencies of all functional groups?

Is there a plan for continuing Engineering support through Phase 5?

Have the needs of affected customers been identified?

If the product is software and a candidate for the DECUS Program Library, have the appropriate forms been completed and submitted?

2.4.7 Phase 5 – Product Retirement (Service Continues)

Objectives: Ensure implementation of the Product Phase Down Plan(s), continue to monitor customer needs, and develop Services Phase Down Plan.

2.4.7.1 Phase 5 Activities

Evaluate assumptions and requirements since the Phase 4B Exit and communicate significant changes to the Product Phase Down Team and appropriate approval bodies.

Ensure that the Product Phase Down Plan developed in Phase 4B is implemented.

Update Product Phase Down Plan with detailed information.

Ensure that Services Marketing develops a Services Phase Down Plan. See Chapter 3 Marketing.

Publish Sales Update article announcing the decision for and conditions of the Product Phase Down.

Conduct a Post–Life Cycle Review.

Remove product from the Price Book and place in the "Service Only" category in the Price File.

Submit Product Phase Down Plan updates to Engineering Product Planning. Notify all affected parties worldwide that Digital plans to phase out sales (and sometimes support of) this product.

Notify the Chief Engineer's Office when the hardware or system product is no longer offered for sale.

Coordinate activities between Manufacturing, Sales, and Services to manage the Product Phase Down Plans.

Conduct a post–life cycle analysis to determine how successfully the product met its Phase 1 Business Plan metrics.

Execute Product Phase Down Plans and adjust as required.

2.5 REQUIRED PRODUCT MANAGEMENT DOCUMENTS

The overview and outline contained in this section serve as guidelines for creation of the Product Requirements Document used by the Product Manager in support of the Phase Review Process. The content, style, and scope of the document described here may vary for hardware and software products. The outline presents the minimum requirements for Product Requirements Documents submitted for Phase Exit approval.

NOTE

Online versions of this outline are available as a VAX DOCUMENT .SDML file and an ASCII file from Standards and Methods Control. Use the following file specification to obtain outlines for the Product Requirements Document.

JOKUR::PHASE_REVIEW:PRODUCT_REQ_PLANS.SDML
JOKUR::PHASE_REVIEW:PRODUCT_REQ_PLANS.TXT

Contact JOKUR::SMC regarding problems copying these files.

2.5.1 Product Requirements Document

OVERVIEW

The Product Requirements Document defines goals for the product in the market place and coordinates worldwide Engineering activities to meet those goals. The document is developed during Phase 0 updated during Phase 1 to define significant activities, deliverables, and schedules. It's purpose, characteristics, audience, and relationship to other corporate activities are described below.

Purpose:

Provide a detailed description of the primary product features and functions intended to satisfy critical needs and success factors identified by market requirements. The document forms the base line for the product specification.

Desired Characteristics:

- Describe the product and how it fits within Digital's product strategy.
- Identify product features and functions intended to satisfy market needs and critical success factors.
- Identify exceptions to Digital standards.
- Identify interdependencies with other products.
- State performance metrics of software and/or hardware.
- Identify major competition.
- Define product transfer costs where appropriate.
- Present the information in a format that shows direct correlation of market requirements and critical success factors to proposed features and functions.

PRODUCT REQUIREMENTS DOCUMENT OVERVIEW (continued)

Audience:

- All functional groups that develop, support, or interface to the product. (Engineering, Manufacturing, Marketing, Sales, CSSE)
- Appropriate review and approval organizations.

Who is Responsible:

- The designated Product Manager with input from Marketing and Engineering.

When Required:

Created during Phase 0.

Relationship to Other Activities:

- Phase 0 Business Plan.
- Alternatives and Feasibility Study.
- Market Requirements Section of the Marketing Plan.

Where Recorded:

- Engineering Product Planning (For Top 100 Products).
- Business Unit (or group sponsoring the product).

PRODUCT REQUIREMENTS DOCUMENT OUTLINE

The following is a suggested outline for the Product Requirements Document.

1.0 EXECUTIVE SUMMARY

A brief summary of the key product aspects that meet stated marketing requirements and critical success factors, and that put this product into perspective as a Digital offering. This section should include summaries of marketing requirements, product requirements, product strategy and product interdependencies.

1.1 Product Goals

- What are the key product features?
- Where does this product fit into Digital's strategy?
- What are the metrics for measuring proposed functionality against customer expectations?
- What are the key performance requirements?
- What are the key compatibility requirements?
- What are the key architectural growth requirements?
- What are the key strengths and weaknesses of the proposed product compared to external (competition) and internal (other Digital) products?
- What are the key innovative areas to protect and maintain intellectual property rights?

1.2 Product Non–Goals

- What are the non–goals for this product?
- What requirements will be put off for the next version of this product?

1.3 Risks and Contingencies

- What are the risks associated with this product?

2.0 PRODUCT CAPABILITIES

Present the requirements for the product based on input from Marketing, Manufacturing, Sales, and Customer Services (through their required documentation). The product requirements and features of this product should be prioritized according to the following scheme:

a. ESSENTIAL – Version n.0 of the product cannot be shipped without this feature. It is a critical feature that, if omitted, would cause most customers not to purchase the product and would also cause major damage to the customers' perception of Digital's strategy.

b. IMPORTANT – Version n.0 of the product should include this feature unless its inclusion jeopardizes the time–to–market goal. The lack of this feature may cause certain customers not to purchase the product, either because it is a feature that is available and used often in current products, or because it is a feature that they have requested and been promised for a long time. This feature must be included no later than Version m.0.

c. DESIRABLE – Version n.0 of the product can be shipped without this feature, but it should be included as soon as possible in a follow–on release. The lack of this feature may cause some customers not to purchase the product and be a source of customer complaint.

- What are the key product features? Why do they exist?
- What will this product (or version of the product) not do?
- What can be observed from outside the product by users, other hardware, and other software?
- What are the product's commands?
- How does the product integrate with other products?
- What is the product's interface design?

3.0 ENVIRONMENT

- What is the environment in which the product operates (physical, user, other products?
- What specifications contain details about the product's environment?

3.1 Users – Target Customers

Develop a user profile to match the skill levels and work habits in the user environment and the product being designed for the environment.

- Who are the target user(s)?
- What are the user's background and skill levels?
- What is the user workflow pattern?
- How does this product satisfy the needs of the target user(s)?
- How will the user use this product?
- Who will purchase this product?

3.2 Hardware Compatibility

- What Digital or non–Digital hardware is required to use this product? Does this product support the required hardware?
- What Digital or non–Digital terminals and printers does this product support?

3.3 Software Compatibility

- What software is required by this product?
- With what operating systems can this product run?
- What layered software, application software, and third–party software are required for this product? Does this product support?
- What distributed software (clusters, networks, communications) can work with this product?
- What products are dependent on this product (hardware, software, and services)?
- What software is dependent on this product?

4.0 PUBLICATIONS AND TRAINING

4.1 Publications

- What documentation and other publications are required for the product?
- What is the purpose and contents of each book in the publication set for the product?

4.2 Training

- What training will be available for the product?
- Does the sales force need training on the product?
- Do software specialists need training on the product?

5.0 PACKAGING

- What aspects of the initial presentation and appearance of the product are desired by the user?
- What is the packaging of the product, including hardware, software, documentation, and shipping containers?
- How will the product be available?
- What kits will be required for the product and what will they contain?
- On what media will product software be distributed?
- Will the documentation conform to *DEC STD 073–0 Manufacturing and Packaging for Publications*?

6.0 INSTALLABILITY

- What does the user desire of the product from the time the package is opened to the time the product is used for the purpose in which it was purchased?
- What needs to done to get the product up and running at the customer's facility?
- What are the goals that allow easy installation of the product?
- What is the projected installation time for the product?
- What installation guidelines should be followed for the product?

PRODUCT REQUIREMENTS DOCUMENT OUTLINE (CONTINUED)

7.0 EASE OF USE

Ease of use requirements are measured in terms of user performance and satisfaction, including the following:

- How can the human interface of the product be tailored to fit the needs of the target user?
- How easy will the product be to use?
- What features make the product easy to use?
- What are the on-line HELP features for the product?
- Will the product use graphical interfaces?
- Into what languages must this product be translated to make it acceptable in the targeted markets?

8.0 PERFORMANCE

- What are the desired performance characteristics of the product's hardware and software under both normal and extreme operating conditions?
- What are the product's memory requirements?
- What are the product's speed requirements for executing specific tasks?

9.0 RELIABILITY

- What are the desired characteristics that affect the user's ability to get tasks accomplished in a dependable, predictable manner?
- How long, typically, will it be between failures of the product (in terms of hours or commands?)

10.0 SERVICE AND MAINTENANCE

- What are the desired characteristics that enable ease of problem diagnosis and correction of the product?
- What features make the product easy to maintain?
- What is the Basic Monthly Cost (BMC) goal for the product?
- What is the planned interval between tested releases?
- What are the requirements for maintenance update procedures?
- What is the desired maintenance service goal for this product?
- What support services will be available to maintain the product?

11.0 MANUFACTURABILITY

- What hardware, software, and documentation needs to be produced?
- Where will manufacturing occur worldwide?
- What special capital equipment is required for manufacturing the product?

12.0 COMPATIBILITY

12.1 Product Compatibility

- What are the desired characteristics that enable the user to move to the product from existing products without undue disruption, and to easily use the product with other Digital and non–Digital products.
- What are the areas of compatibility and incompatibility with existing Digital and non–Digital products?

12.2 Standard Conformance

- How does the product conform to the following:
  - Digital standards?
  - International standards?
  - Industry standards?
  - Installation standards?

13.0 EVOLVABILITY

- What external (vendor) or internal (Digital) products will the product replace?
- What external or internal products will replace the product?
- What are the desired characteristics that enable the product to be adaptable to suit a changing environment?
- What are the requirements that allow customers to modify the product to their own needs?
- Does the product require a capability to be extended and transported for migration to other processors or operating systems, such as Ultrix–32 or MS–DOS?

14.0 INTERNATIONALIZATION

- What are the requirements for internationalization of this product? Refer to the Internationalization Plan from International Engineering Development (IED) .
- Does the product follow guidelines provided by International Engineering Development (IED)? Refer to the following documents:
  - EL–SM498–00, *Producing International Products Handbook*
  - EL–ENGRS–OM, *Internal Guide to Digital Organizations*

15.0 CRITICAL SUCCESS FACTORS

- What are the product's critical dependencies?

15.1 Costs

- What are the proposed transfer cost goals for the product?
- What are desired constraints associated with the development cost to Digital?
- What are the desired constraints associated with the product cost to the user?
- What manpower and equipment resources are required to develop the product in a timely fashion?

15.2 TIMELINESS

- What are the constraints associated with the delivery schedule of the product?
- What are the requirements (constraints) that must be fulfilled for the product to be acceptable?
- How is the product dependent on other hardware and software development projects? What are their schedules?
- What is time frame (window of opportunity) to develop the product to generate an adequate return on investment?
- What are the tradeoffs among product features, or between features and schedule demands?
- What are the guidelines for making tradeoff decisions?
- What are the additional special constraints and tradeoff priorities, if any, assigned to the goals, capabilities, and external characteristics described in this Product Requirements Document?
- What are the possible tradeoffs that can and cannot be considered in meeting the goals described in this Product Requirements Document?

16.0 OUTSTANDING ISSUES

List the following in chronological order, by required completion date:

- Outstanding issues in order of importance
- Names of people responsible for resolving issues
- Completion dates

As issues are resolved, document the resolution of the issue in this document and date the item in this section. All outstanding issues should be resolved before Phase 0 commitment to this Product Requirements Document.

17.0 INTELLECTUAL PROPERTY PROTECTION

- Are innovative technologies being considered for patent invention disclosures?
- Are product trademarks being developed to maximize market pull produced by successful trademarks?

Chapter 3

MARKETING

3.1 PURPOSE

Marketing uses the Phase Review Process as a tool to manage products and systems throughout their life cycle in order to meet market requirement with timely product introductions, mid–life enhancements, and quality phase down support.

The Marketing Plan documents the goals set for the product in the market place and coordinates the worldwide activities to meet those goals. Where a fundamental choice has been made, the plan should document the reasons for making it. The Marketing Plan should not document all the data and understanding on which the plan is based.

The Phase Review Process provides a forum for integration of Industry, Channels, Services, Product Marketing Group (PMG), Base Product Marketing, European Systems Strategy Marketing, and GIA Marketing Plans.

3.2 FUNCTIONAL RESPONSIBILITIES

It is Marketing's role to understand customers' needs worldwide and translate those needs into the best solutions strategy that maximizes Digital's ability to profitably address them.

The Marketing member of the Product Team is responsible for gathering information from applicable marketing organizations and the three Geographies (Europe, General International Area, and U.S.). Marketing functions and responsibilities are distributed across a number of organizations – Base Product Marketing, Product Marketing, Industry Marketing, Channels Marketing, Field Service Marketing, European Systems Marketing, and GIA Marketing.

3.2.1 Base Product Marketing

Base Product Marketing (BPM) focuses on marketing a specific set of products and is part of the Product Business Unit (PBU) that owns the product.

The designated PBU Product or Marketing Manager, with assistance from corporate marketing organizations, is responsible for the Marketing Plan. The Marketing Plan describes the marketing context in which the product is developed. The plan shall include:

- Identification and quantification of market opportunities that offer profitable and/or strategic business opportunities to the Corporation worldwide.
- Presentation of evolving product and service requirements of customers, segmented according to the Digital organizational structure (Geographies, Channels, Services, Industries, and PMGs).
- Determination of the potential for Digital's competitive advantage and development of an overall competitive positioning.
- Definition of market strategy, positioning, and messages.
- Specific marketing activities and programs.

3.2.2 Marketing Advisory Board (MAB)

The Marketing Advisory Board (MAB) is the vehicle for the initiation of formal interaction between the Product Business Units (PBUs) and the PMG, Industry, and Services Marketing groups for implementation of the Phase Review Process. The process for MAB involvement with individual products is described below.

On a regular basis MAB reviews the Top 100 Products, identifies Strategic Marketing Products, and notifies the Product Managers. For these Strategic Products:

- The full MAB or a smaller subset of the marketing groups represented on the MAB reviews the product during the Phase Review Process.
- MAB identifies a Team that will be directly involved with Base Product Marketing (BPM) in the development of the Marketing Plan and agrees on an appropriate, cross–functional marketing strategy and action plan.
- The Marketing member of the Product Team informs the MAB Team of the Phase Exit date at least one month prior to the Phase Review Meeting for Phases 0 and 1, and no less than two weeks prior for Phases 2 through 4B. In addition, the Marketing member of the Product Team is required to provide to the MAB Team review copies of the Business Plan, the Marketing Plan, and the Sales Plan.
- The MAB Team represents marketing groups at Phase Exit Reviews.

3.2.3 Product Marketing

The Product Marketing Group (PMG) is responsible for integrating Base Products with vertical or horizontal applications and marketing these as complete solutions to customers' computing problems.

PMG engineers integrate solutions in the Systems Engineering function. Systems Engineering provides generic product requirements in the context of Base Products. In addition, the PMG represents Industry, Channels, and Services Marketing in the Phase Review Process.

Product Marketing Groups are responsible for:

- Defining product requirements in the context of base platforms that meet the needs of all marketing groups (PMG, Industry, Channels, and Services).
- Communicating competitive information in an application context to BPM.
- Defining Solution Systems that integrate the product and characterizing them, when applicable.
- Developing and implementing an Applications Characterization Plan when applicable.
- Supporting announcements by:
  - Participating in Announcement Strategy Committee (ASC).
  - Integrating announcement into PMG programs.
  - Providing PMG messages for input to Sales Training and announcement literature.
  - Identifying strategic accounts for marketing seed units and testimonials.
  - Providing the following specific PMG deliverables:

    Communication content
    Positioning
    Messaging
    Application mapping
    Performance characterization
- Reviewing the Top 100 Products as members of the Phase Review Committee.
- Forecasting volumes through the 8–Quarter Volume Plan.
- In addition to the MAB–initiated process for Strategic Marketing Products, PMG is responsible for directly supporting and contributing to the Marketing Plan when:
  - A PMG has a specific, strong interest in a product.
  - Industry Marketing has a specific, strong interest in the product.
  - Requested by the Product Marketing Strategy Committee (PMSC) or Executive Committee.

3.2.4 Industry Marketing

Industry Marketing acts as the team leader in driving the development of the Field Marketing Plan organized by industry, by specific account, and by application opportunity. Industry Marketing is responsible for clearly defining the "mission critical applications" in each of the targeted industries, and articulating the needs of those industries to Base Product Marketing, Product Marketing, Channels Marketing, Sales, and Services.

Industry Marketing is responsible for:

- Identifying Strategic Marketing Products for each industry during the MAB review of the Top 100, including:
  - Providing industry strategy information and market requirements for targeted industries during Phase 0.
  - Identifying "mission critical applications" for targeted industries.
  - Reviewing Phase 0 Marketing Requirements and Phase 1, 2, and 3 Marketing Plans.
  - Contributing to the Industry Programs section of the Marketing Plan during Phases 1 and 2.
- Participating in Field Test Site selection for all products.
- Directly supporting announcements by:
  - Participating in Announcement Strategy Committee (ASC).
  - Integrate Announcement into Industry Marketing programs.
  - Providing industry messages for input into sales training and the announcement literature.
  - Identifying strategic accounts for marketing seed units and testimonials.

3.2.5 Channels Marketing

Channels Marketing is responsible for developing indirect channels and marketing Digital products to and through these channels. Specifically, Channels Marketing's goals are to:

- Articulate the product needs of indirect channels to Digital.
- Develop and execute a comprehensive strategy for how indirect channels will sell Digital's products to non–DBA accounts.

  A Digital Business Agreement (DBA) is a contract a customer signs with Digital to purchase a certain amount of Digital's products, qualifying the customer for discounts on those products.
- Continue implementation of the Partners Strategy to build the Corporate Applications Portfolio.
- Provide promotion and education to the marketplace, and within Digital, on how this All–Channels Strategy creates a competitive edge.

Channels Marketing is responsible for:

- Participating in PAC and Marketing and Strategy Committee (MSSC) to ensure that Digital's products are priced, discounted, and positioned properly for the indirect channels.
- Directly supporting product announcements by:
  - Participating in the ASC and in–field announcement activities by ensuring that indirect channel messages are included.
  - Integrating announcement into Channels Marketing programs.
  - Providing Channels messages for input into sales training and announcement literature.
  - Identifying strategic accounts for marketing seed units and testimonials.

3.2.6 Field Service Marketing

Customer Services Systems Engineering (CSSE) Marketing is responsible for the strategic marketing of Digital's services for Field Service. Note: the Maintainability Engineering role of CSSE is defined in Chapter 7 of this manual.

CSSE Marketing is responsible for:

- Writing and distributing the Field Services Market Appraisal on an annual basis.
- Supporting product announcements.
- Working with CSSE Product Managers, BPM, and Geographies to define services for products, and strategic programs.
- Defining the service market strategy, positioning, messages, and ensure integration with BPM.
- Supporting Service Product Managers and Geographies in the pricing of services.
- Identifying an individual to be a member of the MAB Team, which assists in the development of the Marketing Plans. The extent of involvement will be product dependent.
- Working closely with Educational Services and Software Services as their activities influence the Field Service Business.

3.2.7 European Systems Marketing

European Systems Marketing is responsible for developing:

- Tactical programs that directly affect short term goals.
- Longer term strategic programs, including development and implementation of the European Market and Product Requirements Process.

  This task is driven by the Systems Strategy Market Planning, group, which shall:

  — Review the Central Engineering Top 100 list (for products in Phase 0) and provide a prioritized list of strategic Product and Market requirements for Europe.

  — Collect inputs from Country Marketing, European Industry Marketing, Channels Marketing, and International Engineering.

  — Analyze any gap between Corporate plans and the European priority list for a Central Engineering/PBU/PMG response to this gap.

3.2.8 GIA Marketing

GIA Marketing is organized into the following groups:

- Industry Marketing
- Product Marketing
- Software Services Marketing
- Field Service Marketing

These groups parallel Corporate Marketing efforts with the intent of identifying and supporting specific, unique requirements within the diverse markets of GIA.

GIA has established a Product Strategy Committee (GIAPSC) as a subcommittee to the GIA Management Committee (GIAMC). GIAMC includes the Vice President of GIA and the country managers. The GIA Product Strategy Committee is chartered to ensure that GIA has products for its unique requirements.

The mission of the Product Strategy Committee is to affect GIA product strategy supporting the Geographies' Long Range Plans (LRPs), and maximize the return on engineering investment.

GIA Product Strategy Committee objectives ensure that:

- Regional requirements and priorities are reflected in overall GIA product specific strategies.
- GIA product strategy is responsive to GIA Intergrated Industry Marketing Plan (IIMP) submissions.
- The GIA product strategy is integrated into GIA's Central Engineering, Product Marketing Groups, Software Services Engineering (SWS/E), and Computer Special Systems (CSS) Long Range Plans.
- The GIA Product Strategy Committee evaluates the impact of future corpo– rate products and adapts the GIA product strategy as required.
- The Product Strategy Committee provides a forum to review major GIA specific engineering proposals as they effect the GIA product strategy.

In support of the Phase Review Process, the GIA Product Committee will:

- Identify and make visible to Central Engineering product modifications and gaps that effect the GIA Product Strategy.
- Act as an influencing body on behalf of GIA on Corporate Product Strategies and priorities.
- Understand the requirements to support third party applications to ensure that they are incorporated into the GIA Product Strategy.

The GIA Product Strategy Committee membership includes managers of Software Systems Engineering (SWS/E), GIA Engineering, Computer Special Systems (CSS), Product Marketing, Product Planning, Industries Marketing, Asian Base Systems Software, and Software Systems Marketing. GIAPSC can be contacted through Les Dole, the Product Strategy Committee secretary. (See ELF for contact information.)

3.3 MARKETING ACTIVITIES AND DELIVERABLES

Marketing's responsibilities throughout a product's life cycle are shown in Figure 3–1.

Figure 3–1: Marketing Activities and Deliverables

PHASE					
0	1	2	3	4A 4B	5
MARKETING PLAN					
Market Requirements and Strategy	Detailed Market Plan	Pre-product Announcement		Post-product Announcement	
Market Definition and Description					
Marketing Objectives and Strategies					
Situational Analysis, Including Competitive Analysis and Positioning					
Marketing Tactics (Programs) (Product Features, Pricing, Distribution, Promotion)					
	OBJECTIVE WITHIN PLAN - PLANNING				
Marketing Objectives and Strategies	Marketing Programs, Volumes, and Pricing	Intro and Announcement Plan	Product Life-Cycle Strategy	Phase Down Plan	Product Replacement Plan
	OBJECTIVE WITHIN PLAN - EXECUTION				
	Review Specifications Against Requirements	Product Announcement Plan	Product Announcement and Information	Marketing Programs	Product Phase Down

Fig3_1

3.4 EXECUTING AND EXITING EACH PHASE

Each phase in the product's life cycle provides a mechanism for the systematic review of proposals, plans, and results in a manner that allows for controlled funding, resource allocation, and project approval.

For each phase in this chapter, there is a list of exit criteria, supporting activities, and a set of questions that serve as memory joggers for the Marketing Manager of the project. These questions are not all–encompassing — their purpose is to stimulate the thought process and surface issues as early as possible in each phase.

3.4.1 Phase 0 – Strategy and Requirements

Objective: Define and document Market requirements and strategies.

3.4.1.1 Phase 0 Exit Criteria

Market requirements and strategy section of the Marketing Plan written, reviewed, approved, and published. (This document written with input from PMG, Industry, Services, Channels, European Systems Marketing, and GIA Marketing.)

Application portfolio matches the marketing strategy.

Customers' service needs identified.

Approved Phase 0 Marketing Plan submitted to the PBU or sponsoring organization for archiving. Copy of the plan submitted to Engineering Product Planning, for Top 100 Products only.

3.4.1.2 Phase 0 Activities

Perform worldwide Market Analysis with input from European Systems Marketing and GIA Marketing.

Provide an understanding of targeted customers segmented according to the Digital organizational structure (Geographies, Channels, Industries, Services, and PMGs).

Quantify opportunity and present potential for Digital's competitive advantage.

Document market requirements for the product, including internal and external standards and international requirements.

Provide Market Requirements Chapter of the Marketing Plan.

Position the product.

For Strategic Marketing Products identified by MAB for review:

- Involve the MAB Team and European Systems Marketing in the development of the Marketing Plan.
- Ensure that the MAB Team and European Systems Marking is notified one month prior to the Phase 0 Exit date.
- Provide review copies of the Business, Marketing, and Sales Plans to the MAB Team and European Systems Marketing two weeks prior to the Phase 0 Exit Review.

Define the market strategy, including:

- Target audience
- Pricing
- Promotion
- Messaging
- Market share and tentative volumes
- Geography, Industry, PMG, and Channel segmentation
- Services
- Impact on existing marketing programs

Inform MAB and European Systems Marketing when product appears on Phase Review Committee (PRC) agenda.

3.4.1.3 Phase 0 Memory Joggers

Who are the customers we want to target, according to the Digital organizational structure (Geographies, Channels, Industries, Services, and PMGs)? Why? Why not?

Who is the competition?

What is the product "vision"?

What are the features and attributes of the product that provide Digital's competitive advantage? Have the following been considered?

- Functionality
- Relevant customer performance metrics
- Physical environment
- Cost model
- Cost of ownership
- Primary user interface
- Display requirements
- Computing environment
- Data model

- Availability/Reliability requirements
- Computing services needed
- Upgrading requirements
- Services provided
- Vendor reputation

Does the applications portfolio, when applicable, match the marketing strategy?

Does the product require development of a significantly different application performance testing effort? Include marketing personnel in this consideration.

Do product or application characteristics exist that require a significant training effort? Include marketing personnel in this consideration.

Has the opportunity been sized in terms of market share, revenue, and units?

Has the product been positioned relative to other Digital products and the competition in terms of functionality, performance, and price?

If there are questions on product positioning, have you consulted the MAB?

Why develop the product?

What Solution Systems require this product?

With what standards (Digital, International, de facto, customer) must the product comply?

What requirements are driven by the environment in which the product will be used?

What are the distribution requirements?

What are the key market messages?

Do the Industry Marketing groups support the industry strategy?

Has PMG agreed to the applications strategy?

Has Services Marketing agreed to the service delivery strategy?

Does Channels Marketing support the channels strategy?

Have market and technology risks and dependencies been identified?

Does this product replace an existing Digital product? If so, identify the replacement product.

3.4.2 Phase 1 – Planning and Preliminary Design

Objective: Prepare a detailed Marketing Plan that includes specific programs.

3.4.2.1 Phase 1 Exit Criteria

Assumptions and requirements evaluated since the Phase 0 Exit. Market requirements updated, if required, and significant changes communicated to the Product Team.

A detailed Marketing Plan, including specific marketing programs, written, reviewed, approved, and published.

Marketing Plan Executive Summary available for the Phase 1 Business Plan.

Industry Marketing in agreement with the proposed selection of Field Test Sites.

Estimated number of units required for Phase 2 and Phase 3 activities supplied to Product Manager.

Approved Phase 1 Marketing Plan submitted to the PBU or sponsoring organization for archiving. Copy of the plan submitted to Engineering Product Planning, for Top 100 Products only.

3.4.2.2 Phase 1 Activities

Update Marketing Plan from Phase 0 (including input from European Systems Marketing, and GIA Marketing).

Present marketing objectives and strategies (including pricing, promotion, competitive positioning and distribution), along with preliminary details for specific programs and tactics for product.

Define the extent to which customers will view this product as complementing or overlapping other Digital products.

Provide input for the Sales Plan and Business Plan of Record.

Ensure that marketing goals are detailed and specific, including volumes, pricing, distribution, and promotion.

Define the set of cross-functional and external marketing programs required to merchandise the product, or to impact existing programs.

Define an Applications Characterization Plan that ensures availability of appropriate product positioning.

Review and obtain approval for the Marketing Plan from all contributing organizations.

For Strategic Marketing Products identified by MAB for review:

- Involve the MAB Team and European Systems Marketing in the development of the Marketing Plan.
- Ensure that the MAB Team and European Systems Marketing is notified one month prior to the Phase 1 Exit date.
- Provide review copies of the Business, Marketing, and Sales Plans to the MAB Team and European Systems Marketing two weeks prior to the Phase 1 Exit Review.

Ensure that marketing input has been provided to the PBU for the creation of the Proprietary Information disclosure (PID).

Develop a plan for units intended for characterization, application development and conversion, and promotion.

If required, establish a Marketing training program and obtain required resources.

3.4.2.3 Phase 1 Memory Joggers

Have market conditions changed? If so, have they changed our plans?

Have the product goals in terms of market share, revenue, and units for each year of the product's life cycle been forecasted?

Have risks and dependencies been quantified in terms of impact on product goals?

Has product promotion been defined in terms of specific programs, and have the owners of these programs been identified?

Has the type of product announcement been determined? Include input from European Systems Marketing, and GIA Marketing.

Have metrics been defined by which product success is known?

Have resource and the budget requirements been established and approved for each program?

Are all contributing organizations firmly committed to the programs?

Has the Product Manager received input for the Pre-FRS Unit Plan?

3.4.3 Phase 2 – Design and Implementation

Objective: Develop announcement plans, messages, activities, and positioning in close cooperation with the Announcement Consultant or Product Manager.

3.4.3.1 Phase 2 Exit Criteria

Assumptions and requirements evaluated since Phase 1 Exit. Marketing Plan updated, if required, and significant changes communicated to the Product Team.

Marketing Plan updated to include detailed announcement messages and activities.

Approved Phase 2 Marketing Plan submitted to the PBU or sponsoring organization for archiving. Copy of the plan submitted to Engineering Product Planning, for Top 100 Products only.

3.4.3.2 Phase 2 Activities

Review, revise, and provide further detail concerning the marketing objectives, strategies, tactics and programs for the product.

With Corporate Product Operations, determine applicability of the *Corporate Product Introduction Guide* to the product.

Provide input for Sales Plan and Business Plan.

Update Marketing Plan from Phase 1.

Develop announcement messages.

For Strategic Marketing Products identified by MAB for review:

- Involve the MAB Team in the development of the Marketing Plan.
- Ensure that the MAB Team is notified at least two weeks prior to the Phase 2 Exit date.
- Provide review copies of the Business, Marketing, and Sales Plans to the MAB Team at least two weeks prior to the Phase 2 Exit Review.

Review and obtain approval of the plan from all contributing organizations.

Ensure that marketing input has been provided to the PBU for the creation of the Proprietary Information Disclosure (PID). See *Corporate Proprietary Information Disclosure Policy*.

3.4.3.3 Phase 2 Memory Joggers

Have market conditions changed? Has the schedule changed? If so, do we need to revise the marketing strategy? Are these changes reflected in the applicable plans?

Have announcement messages been communicated to the Product Captain?

Have the contributing organizations committed to supporting the Marketing Plan?

If the *Corporate Product Introduction Guide* applies, has the Announcement Captain and Announcement Team been identified?

Have targeted Industry Marketing groups incorporated the product announcement into their field programs?

Is Channels Marketing prepared to support the channels strategy?

Is Field Services Marketing prepared to support the service delivery strategy?

3.4.4 Phase 3 – Qualification

Objective: Develop a detailed product life cycle, including pricing, mid–life kickers, and phase down.

3.4.4.1 Phase 3 Exit Criteria

Assumptions and requirements evaluated since Phase 2 Exit. Marketing Plan updated and significant changes communicated to the Product Team.

Applications characterization executed.

Marketing Plan updated to include detailed Product life cycle Program with pricing, mid–life kickers, and phase down.

Approved Phase 3 Marketing Plan submitted to the PBU or sponsoring organization for archiving. Copy of the plan submitted to Engineering Product Planning, for Top 100 Products only.

3.4.4.2 Phase 3 Activities

Review, revise, and detail marketing objectives, strategies, tactics, and programs for the product.

Provide input for the Sales Plan and Business Plan.

Update Marketing Plan from Phase 2.

Develop a detailed Product Life Cycle Program.

For Strategic Marketing Products identified by MAB for review:

- Involve the MAB Team in the development of the Marketing Plan.
- Ensure that the MAB Team is notified at least two weeks prior to the Phase 3 Exit date.
- Provide review copies of the Business, Marketing, and Sales Plans to the MAB Team at least two weeks prior to the Phase 3 Exit Review.

Implement Applications Characterization Plan.

Work with appropriate Sales, PMG, and Industry Marketing organizations to select testimonials for announcement.

Distribute applications characterization information to the appropriate parties in time to impact announcement and field training activities.

3.4.4.3 Phase 3 Memory Joggers

Have market conditions changed? If so, have plans been changed?

Has final pricing, product naming, and product's life cycle been determined?

3.4.5 Phase 4A – Ramp–Up

Objective: Review and revise marketing objectives, strategies, tactics, and programs for the product.

3.4.5.1 Phase 4A Exit Criteria

Assumptions and requirements evaluated since Phase 3 Exit. Marketing Plan updated to reflect market and product changes and significant changes communicated to the Product Team.

Approved Phase 4A Marketing Plan submitted to the PBU or sponsoring organization for archiving. Copy of the plan submitted to Engineering Product Planning, for Top 100 Products only.

3.4.5.2 Phase 4A Activities

Execute Marketing Plan.

Provide input for Sales Plan and Business Plan.

Update Marketing Plan and Announcement Plan as required by market conditions.

3.4.5.3 Phase 4A Memory Joggers

Have market conditions changed? If so, have plans been changed?

3.4.6 Phase 4B – Steady–State Operation

Objective: Describe the Product Phase Down Plan and possible replacement strategy.

3.4.6.1 Phase 4B Exit Criteria

Product assumptions and requirements evaluated since Phase 4A Exit.

Marketing Plan updated to include Product Phase Down and possible replacement strategy.

Approved Phase 4B Marketing Plan submitted to the PBU or sponsoring organization for archiving. Copy of the plan submitted to Engineering Product Planning, for Top 100 Products only.

3.4.6.2 Phase 4B Activities

Review marketing objectives, strategies, tactics, programs, and market performance of the product, and revise the Marketing Plan.

Propose product modifications and enhancements (mid–life kickers) as appropriate.

Update the Marketing Plan to include product replacement strategy.

Develop a detailed Product Phase Down Plan in association with Sales, Services, and other marketing organizations.

Provide input for the Sales Plan and Business Plan.

3.4.6.3 Phase 4B Memory Joggers

Have market conditions changed? If so, have plans been changed?

Is this the final product of the product family or is there a plan to replace it with another product?

What is the strategic reason for replacing the product?

Are there ongoing customer commitments or contracts that affect product phase down?

What are the international implications for product phase down, such as legal requirements and inventory. (Contact Jim Mills, International Engineering Development for more information. See ELF.)

3.4.7 Phase 5 – Product Retirement (Service Continues)

Objective: Implement Product Phase Down Plan and develop Services Phase Down Plan.

3.4.7.1 Phase 5 Activities

Document final customer and contract migration and support strategies for the Services Phase Down Plan.

Update Marketing Plan to include Services Phase Down and submit to Engineering Product Planning.

3.4.7.2 Phase 5 Memory Joggers

Have you considered:

- The Public Relations (PR) required for the Service Phase Down Plan?
- Other available programs (migration or trade–in) and communicated the existence of these programs to the customer base?
- What new or changed services are required for products as they approach their end–of–life?
- The legal impact of remaining contracts?

3.5 REQUIRED MARKETING DOCUMENTS

The overview and outline contained in this section serve as guidelines for creation of the Marketing Plan used by Marketing in support of the Phase Review Process. The content, style, and scope of the plans and documents described herein may vary for hardware and software products, and across Marketing Groups. The outlines present the minimum requirements for the Marketing Plan submitted for Phase Exit approval.

This section contains outlines for the following chapters of the Marketing Plan:

1.0 Executive Summary
2.0 Market Requirements
3.0 Market Strategy
4.0 Market Programs
5.0 Life Cycle Program

NOTE

Online versions of this outline are available as a VAX DOCUMENT .SDML file and an ASCII file from Standards and Methods Control. Use the following file specification to obtain the Marketing Plan outline.

JOKUR::PHASE_REVIEW:MARKETING_PLANS.SDML
JOKUR::PHASE_REVIEW:MARKETING_PLANS.TXT

Contact JOKUR::SMC regarding problems copying this file.

3.5.1 Marketing Plan

OVERVIEW

The Marketing Plan documents goals set for the product in the market place and coordinates the worldwide activities required to meet these goals. The plan is a living document developed and updated during a product's life cycle to define significant activities, deliverables, and schedules. Its purpose, characteristics, audience, and relationship to other corporate activities are described below.

Purpose:

The purpose of the Marketing Plan is to:

- Optimize the revenue and profits that the Corporation will gain from the product.
- Document market programs needed to achieve the established goals.
- Identify and quantify market goals that present profitable and/or strategic business opportunities.

Desired Characteristics:

Presentation of market requirements from the customer's perspective.

Information that is continually updated as marketing intelligence improves and as marketing programs are initiated, reviewed, and/or modified.

MARKETING PLAN OVERVIEW (continued)

Audience:

BPM, Sales, PMG, Industries, Services, and Channels Marketing.

Who is Responsible:

The designated PBU product or Marketing Manager with assistance from corporate marketing organizations.

When Required:

A Marketing Plan is required for each Phase exit transition throughout a product's life cycle beginning in Phase 0 (with the exception of Phase 5 closure).

NOTE

> A Market Requirements proposal can be prepared at any time throughout a product's life cycle to recommend further development, enhancement, or modification.

Relationship to Other Activities:

- **Business Plan** – The Executive Summary of the Marketing Plan is included in a product's Business Plan.
- **Product Requirements Statement** – The needs documented in the Market Requirements chapter of the Marketing Plan are translated into the product requirements detailed in the Product Requirements Statement.

Where Recorded:

- Engineering Product Planning.

MARKETING PLAN OUTLINE

1.0 EXECUTIVE SUMMARY – Chapter 1
(Written in Phase 0; updated in Phases 1, 2, 3, 4A, 4B, and 5)

Purpose: To communicate a concise, accurate overview of the market requirements, strategy, major dependencies, and risks.

Outline:

1.1 Strategy
1.2 Goals
1.3 Key success factors
1.4 Competitive advantage
1.5 Market forces
1.6 Pricing
1.7 Programs
1.8 Dependencies and risks

2.0 MARKET REQUIREMENTS – Chapter 2
(Written in Phase 0; updated in Phases 1, 2, 3, 4A, and 4B)

Purpose:

- To identify and quantify market opportunities that present potentially profitable and/or strategic business opportunities worldwide.
- To present the potential for Digital's competitive advantage.

Outline:

2.1 Opportunity
2.2 Needs
2.3 Requirements

Geographies
Industries
PMGs
Services
Channels

2.4 Competitive Issues
2.5 Market Forces

3.0 MARKET STRATEGY – Chapter 3

(Written in Phase 1; updated in Phases 2, 3, 4A, and 4B)

Purpose: To outline the course of action required to successfully penetrate, increase, or maintain desired market position or profitability.

Outline:

3.1 Business Objectives
3.2 Positioning
3.3 Volumes
3.4 Pricing
3.5 Life Cycle
3.6 Messages
3.7 Indicators
3.8 Measures of Success

4.0 MARKET PROGRAMS – Chapter 4
(Written in Phase 2; updated in Phases 3, 4A, and 4B)

Purpose: Integrate all marketing components into a comprehensive program for coordinated action at all marketing levels.

Outline:

- 4.1 Systems Engineering
- 4.2 Characterization
- 4.3 ACT programs
- 4.4 Industry programs
- 4.5 Services programs
- 4.6 Application Concession and Capture
- 4.7 Packaging
- 4.8 Proprietary Information Disclosure
- 4.9 Announcement and Introduction
- 4.10 Promotion and Merchandising
- 4.11 Competitive
  - Attack
  - Protect

5.0 LIFE CYCLE PROGRAM – Chapter 5
(Written in Phase 3; updated in Phase 4A, 4B, and 5)

Purpose:

The purpose of the Life Cycle Program is to define the Marketing requirements, activities, deliverables, and an implementation strategy for the remainder of the product's life.

Outline:

5.1 Pricing Adjustments
5.2 Mid-Life Kickers
5.3 Replacement Strategy
5.4 Indicators
5.5 Services

Chapter 4

ENGINEERING

4.1 PURPOSE

Digital's Engineering function uses the Phase Review Process as a tool to:

- Propose product concepts for commercialization.
- Support development efforts funded through the Long Range Planning (LRP) and budget process.
- Manage and review the quality of Engineering plans that cross organizational boundaries.
- Facilitate the development of products on schedule and at budgeted cost, with expected functionality, manufacturability, and serviceability.
- Provide tangible evidence that the product meets its stated specifications and requirements.
- Improve product and system predictability.

4.2 FUNCTIONAL RESPONSIBILITIES

4.2.1 Development Engineering

Engineering is responsible for developing products consistent with the Corporate Product Strategy. These responsibilities include:

- Proposing product concepts for commercialization, including supporting projects and their budgets.
- Selecting appropriate technology to satisfy product requirements.
- Creating and implementing plans to specify, design, develop, test, release, and support worldwide products.
- Identifying the intellectual property content of products for legal protection consideration.

4.2.2 Support Engineering

Support Engineering provides ongoing technical support of released products, including ongoing maintenance of the design, implementation of Engineering Change Orders (ECOs), and Value Engineering (VE). Support Engineering shall deliver or participate in the development of the following information:

Design Reviews	Phase 0 through 4B
Phase Exit Reviews	Phase 0 through 4B
Product Support Transition Plan	Phase 1
Engineering Change Orders	Phase 3 through 4B
Value Engineering Proposals and Plans	Phase 1 through 5
Product Phase Down Plan	Phase 5

NOTE

Value Engineering activity may be planned in Phase 1 and initiated in Phase 2 on certain products.

4.3 ENGINEERING ACTIVITIES AND DELIVERABLES

Figure 4–1 shows Engineering activities and deliverables for the Phase Review Process.

Figure 4–1: Engineering Activities and Deliverables

PHASE					
0	1	2	3	4A 4B	5
Prel Eng. Dev. Plan →	← Engineering Development Plan →				
Alt./Feasibility Study Input to Prod. Requirements	Functional Spec.	Design Spec. (proto build/test)	Testing complete (ready to Ann./Frs)		
	← Detailed Supporting Plans →	Test Plans Verification Plan Design complete Proto types build Functionality verified Revision Control	Qualification Plan DEC STD/Regulatory Testing complete Pilot/Field Test seed units build Performance Characterization ECO control	Specified ECO cost resp. transferred to Manufacturing	
	← Prod. Support Eng. Plan →	← Detailed Support Engineering Plan →		Transfer to Support Eng. Eng. Support in place ECO resp. in Support Engineering	Input to Phase Down
	← Documentation Plan →	Preliminary documentation available	← Released documentation available →		

Fig4_1

4.4 EXECUTING AND EXITING EACH PHASE

Each phase in the product's life cycle provides a mechanism for the systematic review of proposals, plans, and results in a manner that allows for controlled funding, resource allocation, and project approval.

For each phase in the process, there is a list of Exit Criteria, supporting activities, and a set of questions that serve as memory joggers for the Engineering Manager of the project. These questions are not all–encompassing; their purpose is to stimulate the thought process and surface issues as early as possible in each phase.

4.4.1 Phase 0 – Strategy and Requirements

Objective: Propose products that take advantage of current or emerging technology; demonstrate technical feasibility of selected technologies through simulation, analysis, or modeling; satisfy market and product requirements; and fit the Corporate Product Strategy.

4.4.1.1 Phase 0 Exit Criteria

Project manager assigned by the Development Group with the authority and responsibility to carry out the project.

Alternatives and Feasibility Study written, reviewed, approved, and published.

Product's technical feasibility demonstrated.

The protection of the product's intellectual property rights coordinated through the Engineering Law Group.

Digital, industry, and country–specific standards and requirements for the Engineering Development Plan identified. Contact Domain Manager(s) as needed. For more information refer to the Internationalization Plan from International Engineering Development and the following standards:

- *DEC STD 066–3 Policy for Designing Products for All Countries Designated as Strategic Markets*
- *DEC STD 060–0 Design of Hardware Products to National and International Standards, Policies, and Responsibilities*

Preliminary Functional Specification (technical product proposal) written reviewed, approved, and published.

Preliminary Engineering Development Plan written, reviewed, approved, and published.

NOTE

The Preliminary Functional Specification and Preliminary Engineering Development Plan take into account identified requirements from:

- All countries designated as strategic markets (DEC STD 066–3)
- International Engineering Development (Internationalization Plan)
- Corporate Export and Trade (CE/T)
- Engineering Law Group
- Digital, industry or country–specific standards and requirements

Engineering Law Group contacted if development activities involve third parties. Appropriate agreements with third parties are in place.

Potential vendors identified and feasibility and costs evaluated for buyout products.

Engineering Executive Summary prepared for the Phase 0 Business Plan.

Copies of approved Phase 0 Engineering exit plans submitted to the Product Manager.

4.4.1.2 Phase 0 Activities

Evaluate and document alternatives and technical feasibility. What are the risks and how will they be managed?

Demonstrate that the critical aspects of the product are technically feasible and ready for development.

Obtain Internationalization requirements from the International Engineering Development (IED) Product Manager. (Contact Jim Mills in IED to locate this resource. See ELF for contact information.

Identify potentially protectable inventions or developments (Legal Protection Strategy).

Evaluate Manufacturing, Sales, and Service impact statements and factor into the Preliminary Functional Specification.

Provide technical input to the Product Requirements Document.

Describe the process methodologies (tools and processes) required to:

- Design
- Test
- Manufacture
- Diagnose
- Transfer data between functions, such as Engineering and Manufacturing

When valid hardware or system option and part numbers are required in the initial design, Contact the Chief Engineer's Office for assignment and approval of these hardware or system part numbers. Be prepared to discuss product architecture, functional design parameters and product packaging. For example, Engineering may need a hardware part number:

- When the logic is completed
- When a valid list of component products needs Digital unique identity
- After prototype release
- Before releasing a product to manufacturing
- When engineering gets approval to build or sell
- When a buyout product has been approved

4.4.1.3 Phase 0 – Memory Joggers

Are there sufficient clarity and detail in the Product Requirements document to create a complete Functional Specification?

Have the functional impacts and requirements from Marketing, Manufacturing, Sales, and Customer Services been considered?

Is the product consistent with the Engineering Long Range Plan (LRP) and the Corporate Product Strategy?

Do Phase 0 Engineering documents address the Internationalization requirements identified in the Internationalization Plan (I18N Plan)?

Have all aspects of the proposed product been examined for intellectual property content, (including architecture, design, operation, hardware components, software components, and process methodologies)? Have these aspects been reviewed by the PBU Intellectual Property Committee or equivalent and a decision reached to pursue protection?

Has appropriate intellectual property protection been pursued?

Have potential conflicts with patents, trademarks, and copyrights been researched?

Have the applicable Digital and external standards been identified and listed? Have the appropriate Domain Managers and standard owners been contacted to verify applicability of the identified Digital standards? Refer to *DEC STD 066–1 Technical Domains in the Product Development Process.*

Have you contacted the owners of standards that may apply to the product, but whose requirements will not be implemented?

Are there any design factors not currently addressed by Digital standards or external standards? How will you address these factors?

Have certification, regulatory, and performance requirements (based on market and product requirements) been defined?

Is the proposed design compatible with associated test equipment and methodologies? If not, is testing addressed in the Alternatives and Feasibility Study?

What new test tools or methodologies are required?

Have the process aspects of the project (process/method definition and tool selection) been reviewed by an appropriate group of independent process experts, or has the review been waived?

Are the product performance parameters, such as Mean Time Between Failures (MTBF), constrained by the manufacturing process or have they been determined by competitive product positioning? If the production process is a limiting factor, what process improvements are needed to meet product design goals? Who is addressing this issue?

What design tools will be used for each design stage? Who (what group) provides each tool and its support?

Have all process constraints to be incorporated in the product design, including manufacturing and test, been obtained from the process development organizations?

Have Manufacturing constraints been incorporated in the design tools to be used for use in development work? If not, who is addressing these issues and in what time frame are constraint–checking tools expected to be available?

On what libraries, such as component, model, and simulation, is the product dependent? From where will these libraries be supplied ? Who supports the use and extension of these libraries?

Does the product involve new manufacturing and test processes that have not been used in past volume production? If so, what are these processes? Have they been tested in advanced development facilities? Who are the process development partners supporting the work?

How will you deal with manufacturing or process constraints if the design tools are not upgraded?

What changes (or inventions) is the product dependent on in current manufacturing physical technologies and test technologies? Who is driving these changes?

Who is extending the design tool and data transfer process to support changes to manufacturing physical technologies and test technologies?

What data will Manufacturing require to build the product?

What revision management, ECO, and manufacturing feedback processes will be used?

What product-specific data and schedule generation activities are required of the Product Team or other resources?

Is the Internationalization Plan available?

Has Product Safety Engineering assigned an engineer? Refer to the Phase 0 section of *DEC STD 119-5 Process for Design, Evaluation, Testing, and Certification of Hardware Products to Product Safety Requirements* for more information.

What is your overall methodology and design process (independent of design tools)?

Have the product's high-risk components been identified?

Have you initiated vendor-Digital contact with Purchasing?

Have vendors for crucial parts of the design been contacted and evaluated?

In what manner does the development of the following occur: design rules, timing analysis, logic entry, physical partitioning, physical layout, physical verification, physical–to–logical reconciliation, and technology characterization?

How are the mechanical and analog design performed? What tools are required?

How are electrical, thermal, and reliability analysis and verification performed? (What tools or groups will be part of this process?)

What is the Product Test Strategy; Engineering Test Strategy; Manufacturing Test Strategy; and Field Service diagnostic, test, and repair strategies?

What are the Problem Free Installation (PFI) goals?

What are the Mean Time To Repair (MTTR) goals?

What are the Mean Time Between Failures (MTBF) goals?

What are the Availability (from a customer viewpoint) goals?

Have the computing and database requirements for developing the product been decided? How has this been validated?

What changes are required in other products for this product to function most efficiently? Have the groups responsible for affected products been contacted?

4.4.2 Phase 1 – Planning and Preliminary Design

Objectives: Create complete functional specifications and a preliminary design for the total product offering.

Provide the Corporation with an Engineering Development Plan plan for Phases 2 through 4A.

Obtain agreement of the Product Team to build the product identified in the Functional Specification. (This specification will not be altered in subsequent phases without agreement by the Product Team and approval of the PBU or sponsoring organization).

Identify cross–product interdependencies and implement plans to manage these situations.

4.4.2.1 Phase 1 Exit Criteria

Assumptions and requirements evaluated since the Phase 0 exit. Significant changes communicated to the Product Team and appropriate approval bodies.

Complete Functional Specification addressing requirements identified in Phase 0 written, reviewed, approved, and published. All committed features and functions documented in the Functional Specification.

A Legal Protection Strategy is in place, including updates to the Phase 0 Strategy.

Engineering Development Plan and schedule reviewed and approved by the sponsoring and development group and all impacted functions.

The proposed product is exportable to Digital's strategic countries under current export license requirements, as determined by Corporate Exit and Trade (CE/T) in Washington D.C. Contact is Don Ames. See ELF.

All internal and external Digital, industry, regulatory, and country–specific requirements addressed and included in the Engineering Development Plan for inclusion in the design and, as required, Verification and Qualification Test Plans. For more information refer to the following standards:

- *DEC STD 060–0 Design and Certification of Hardware Products to National and International Regulations and Standards – Policy and Procedures*
- *DEC STD 062–0 Product Submittal to U.S. and Non–U.S. Agencies*
- *DEC STD 066–0 Digital Design Standards*

The part number family assignment plan for hardware products approved by the Chief Engineer's Office. Refer to *DEC STD 012–2 Unified Numbering Code for Part Identifier Class Codes and Related Document Identifiers.* For software products refer to *DEC STD 012–4 Unified Numbering Code – Software Distribution Center Part Numbering Conventions.*

An Executive Summary of the Engineering Development Plan developed by the Engineering Manager for the Phase 1 Business Plan.

Copies of approved Phase 1 Engineering exit plans submitted to the Product Manager.

4.4.2.2 Phase 1 Activities

Evaluate assumptions and requirements since Phase 1 exit, update affected Engineering plans as required, and communicate significant changes in the plans to the Product Team.

Execute Legal Protection Strategies.

Review the technical content of the Proprietary Information Disclosure (PID).

Create Documentation Plan for the total product offering.

Create a Preliminary Support Engineering Plan.

Prior to preliminary design, obtain part numbers from the Chief Engineer's Office for top level system configurations. (This is key for new technologies, new or significant changes to architecture, and system level family of products.) Refer to *DEC STD 012–0 Part and Document Identification Conventions – Digital Corporate Policy* for more information.

Obtain Product Team agreement on the product's functionality and characteristics.

From a functional perspective, define the extent to which this product complements or overlaps other Digital products.

Complete the Functional Specification and Engineering Development Plan based on:

- Product and Market Requirements
- Alternatives and Feasibility Study
- Impact and requirements from Manufacturing, Sales, and Service
- Impact and requirements o all applicable standards
- Requirements identified by IED in the Internationalization Plan

Ensure that the Engineering Development Plan is integrated with interdependent functional plans (funding, schedule, resources, and supporting projects).

Include Risk management and contingency plans in the Engineering Development Plan and schedule.

Review and approve functional plans for supporting development project.

Adjust proposed design to make product easily exportable under current U.S. Export Law.

Model, simulate, or bread–board high–risk features.

Document preliminary test requirements and plans (Verification plans for Phase 2 and Qualification plans for Phase 3).

Identify test groups and schedule testing. Certain tests may begin in Phase 2, such as Design Verification Testing (DVT). Contact VAX New Products Committee (VNPC), Micro New Products Committee (MNPC), or Networks New Products Committee (NNPC) to assist in the determination of system level test requirements.

Supply Product Manager with the estimated number of units required to support Phase 2 and 3 test and qualification activities.

Create plans addressing who, what, and when required process methodologies described in Phase 0 will be delivered.

4.4.2.3 Phase 1 Memory Joggers

Have all aspects of the proposed product (including architecture, design, operation, hardware components, software components, and manufacturing) been examined for intellectual property content?

Has intellectual property protection been pursued?

Does the functional specification address applicable internal and external standards? Have the Domain Managers and standards' owners been contacted to verify applicability of identified standards?

Are there any design factors not currently addressed by Digital standards or external standards? How will these factors be addressed?

How will verification of the product requirements be demonstrated?

Were any identified requirements omitted from the proposed specifications? Why? How will these changes affect the:

- Product
- Customer
- Market strategies
- Sales strategies
- Services strategies
- Manufacturing strategies

Have appropriate commitments been obtained and are they achievable? (Are supporting projects in line with your plans?)

On what hardware and software is this product dependent? What is required? What is optional?

What hardware and software products are dependent on this product? Are plans in place to sufficiently test these products to ensure they work with new product?

For new CPUs, has a list of software required for First Revenue Ship (FRS) been developed? Have resources and prototypes been allocated for required software testing? Have plans been established to ensure that the required software will be available for FRS of the product? (Note: Software includes layered products and applications.)

Does the planned product growth–cycle include meaningful new features? What are these features? What plans are in place to make them available?

What offshoots of this new product will be reviewed for future development?

Have you addressed the following compatibility issues:

- Ergonomics (Human Engineering)
- Physical
- Electrical
- Interfaces (hardware and software)

What changes need to be made in other products to allow this product to function most efficiently? Have the groups responsible for the affected products been contacted? Have they agreed to the changes?

Have Manufacturing, Sales, and Service requirements been incorporated into the Functional Specification? What requirements were omitted and did the functional submittors agree with these omissions?

Does the Functional Specification address the stated Problem Free Installation (PFI) and Mean Time to Install (MTTI) goals?

Will new manufacturing processes be required as a result of the Functional Specification?

Have the product's installation requirements in the customer environment been addressed and are they understood by the Product Team?

Are contingency funds and plans specified in the Engineering Development Plan?

Is the project dependent on key individuals, parts, processes, or products?

Has the product team designated the members of the product qualification team to plan and implement the test, verification, and qualification program per EN–EN522–00, *Digital Qualification Process Manual*?

What is the resources plan for each area of activity, such as Design and/or CAD/CASE, Test, Geographic Adaptation, and Manufacturing Start–Up Engineering?

Do you have adequate resources (quantity and skills) to address project needs?

What, if any, are the major above normal capital investments required?

Will service life be dependent upon hours or cycles of operation? How does this factor affect your proposed design?

Are all product performance requirements defined in the product specification? What are these requirements, and are they agreed to by the Product Team? List unresolved issues.

Have all organizations affected by the project had the opportunity reviewed the proposed Functional Specification to assess its impact on their organizations? Who are the groups and resources in the review cycle?

Have you defined doneness criteria for product base levels?

Have cross–organizational design responsibilities been defined and committed resources assigned?

Have the design, test, and certification to standards or requirements (Digital, industry, country–specific) been factored into the design schedule?

What are the major project milestones?

If the product design was previously used, have you analyzed its cost, yield, and failure history, along with previous test and service results? Is there a current design performance goal that the product was not designed to meet that may push this product beyond its limits?

Have all operating environments been considered in the Functional Specification? What factors have not been addressed?

Will each item of the Engineering Development Plan that is contracted to other organizations be part of the overall schedule? Will each item be monitored to ensure on–time delivery?

Have you included design reviews, specification approvals, drawing releases, parts qualification, and revision control as part of your scheduled milestones?

Are significant GO/NO GO decision points part of the milestone schedule? What are the decision points?

Are there plans to evaluate prototype and first production models against all specification requirements, including software and system by certification Software Quality Management (SQM)? Are all required tools and resources available? How will you handle exceptions?

Have all functional members of the Product Team agreed to the functional specification and schedule? Have they committed resources and funding?

What tools or process steps are required for the next phase?

What is the status of tools or processes being developed for use beyond the next phase? What support will be available for these tools?

4.4.3 Phase 2 – Design and Implementation

Objective: Execute the plans committed to in Phase 1. Complete the detailed design and document complete specifications which may have been started before Phase 0 exit. Translate specifications into product reality. Establish contracts with test organizations as required. Establish revision control of to allow controlled distribution of design corrections.

4.4.3.1 Phase 2 Exit Criteria

Assumptions and requirements evaluated since the Phase 1 exit. Significant changes communicated to the Product Team and appropriate approval bodies.

A Legal Protection Strategy is in place, including updates to the Phase 1 Strategy.

Design Specification for the complete product written, reviewed, approved, and published.

Contracts signed with selected vendors for buyout products.

Product design implemented to meet the Functional Specification. The total product design (including hardware, software, and microcode) declared complete by the Engineering member of the Product Team.

A detailed Product Qualification Plan written, reviewed, approved, and published.

Every feature of the product is functional in at least one configuration representative of the customer environment. (For example: CPU runs all instructions, at speed, with a given operating system.) Product simulation is complete, and timing and performance verified.

Field Test Plan written, reviewed, approved, and published. Refer to EL–EN571–00, *Software Engineering Manual* for more information.

An Engineering Executive Summary prepared for the Phase 2 Business Plan. All deviations or changes from Engineering Phase 1 plans highlighted and explained.

Parts qualification in progress.

Product under revision control, including hardware, software, microcode, and documentation.

The Chief Engineer's Office has approved valid part numbers for the total product offering for hardware and system products only. Refer to *DEC STD 012–2 Unified Numbering Code for Part Identifier Class Codes and Related Document Identifiers*. For software products, refer to *DEC STD 012–4 Unified Numbering Code – Software Distribution Center Part Numbering Conventions*.

Computer Parts List (KPL) completed and on file.

Copies of approved Phase 2 Engineering exit plans submitted to the Product Manager.

4.4.3.2 Phase 2 Activities

Complete the product design.

Evaluate assumptions and requirements since Phase 1 exit. Update affected Engineering plans as required and communicate significant changes to the Product Team.

Verify the design according to test plans. Design Verification requires:

- Complete design Complete
- Simulation complete, timing verified
- Built prototype/software functional code freeze
- All features tested in at least one configuration representative of the customer environment. For example: CPU runs all instructions, at speed, with a given operating system.

- Operation with complementary hardware and software products, such as operating systems with layered products, CPUs with operating systems, and languages with databases.

Hold design reviews and code reviews as appropriate.

Ensure that the product is designed to meet all committed requirements. Clearly state the commitments that have not been met and why this is considered acceptable.

Complete the Bills of Material (BOMs) for all saleable configurations down to component level, and submit the BOMs to Manufacturing.

Document design specifications for the complete product offering (including microcode information).

Supply Product Management with the detailed requirements (actual number of units, schedule, and configurations) supporting Phase 2 and 3 test and qualification activity.

Test and qualify software required for Field Test and FRS.

Write a detailed Qualification Plan that includes:

- Regulatory testing and approvals
- Other Digital standard testing or appropriate external testing
- Performance testing
- Design Maturity Testing (DMT)
- Testing in all supported environments
- Reliability Qualification Testing
- Software certification and evaluation by applicable software quality test groups (such as SQM/SQG)
- Internal Field Testing
- External Field Testing

Create revision matrix document for the complete product offering.

Document configurations and make the information available to the XCON/XSEL group.

Develop simulation and complete coded data.

Complete Support Engineering Plan.

Order prototype material.

Arrange and complete prototype build.

Arrange for test equipment and test beds.

Deliver the product to appropriate test groups as scheduled.

Ensure that documentation drafts are reviewed and available for field test.

Prepare a discrepancy list between "as designed" and "as built" configurations of the product. This should a be joint Manufacturing and Engineering effort to determine accuracy of the product to specification.

4.4.3.3 Phase 2 Memory Joggers

Have any alterations been made to the design that change export license requirements? Document the changes and how they impact product requirements and Functional Specifications.

Have you identified and listed the appropriate Digital standards that apply to this product? Have the appropriate Domain Managers and standard owners been contacted to verify applicability of the identified Digital standards? Refer to *DEC STD 066–1 Technical Domains in the Product Development Process* for a list of the Domain Managers.

Does the change review process include all affected groups?

Is there a specification family tree that shows the interrelationship of all product specifications for the complete product offering?

Does the design take advantage of interchangeable parts from other products? What are these parts?

Have you defined the resources that will execute the requirements of *DEC STD 066–0* and *DEC STD 100–0 Introduction to Engineering Change Orders* requirements?

Have you created and implemented:

- Configuration rules?
- A revision matrix?
- A Change implementation (PCO, FCO, Patch) process?

Have design reviews been held?

Have all handling, shipping, and warehousing distribution requirements been considered in the design process?

Are engineering drawings for all parts of the design available and under revision control?

Has Purchasing obtained and approved pricing for purchased parts? (To be addressed as appropriate for the specific product; must be complete to exit Phase 3.)

Have mating parts been evaluated to determine interchangeability (in general, and for parts from different vendors)?

Are there any new product ideas developed for which intellectual property rights strategies need to be implemented?

What tools or process steps are required for the next phase? What support will be available for these tools?

What is the status of tools or processes being developed for use beyond the next phase?

Have the overall objectives and verification tasks for the product been defined?

What criteria need to be met for success at this phase?

Are the plans for component, product, and system level test and qualification in place?

What will not be tested and why? How will this affect the product and the customer?

Has the first pilot unit been carefully evaluated against drawings and other released documentation to ensure conformance?

What Field Test procedures will be used? Who will be supporting the product in Field Test?

How will Field Test problems be collected, prioritized, corrected, status and results reported, and archived?

Has the Field Test reporting process been defined?

Have the resources responsible for problem management and reporting been identified?

Will self–test features be incorporated where practical? What are these features?

4.4.4 Phase 3 – Qualification

Objectives: Qualify production level copies of the product and demonstrate through internal and external testing and feedback that the product has met its requirements and specifications.

At the completion of the Qualification Test cycle (Phase 3), all product attributes will be accurately characterized and documented. Contracts with test organizations are executed as the product becomes available.

4.4.4.1 Phase 3 Exit Criteria

A Legal Protection Strategy in place, including updates to the Phase 2 Strategy.

Engineering Law Group contacted to review all new aspects of the proposed product for intellectual property content. Additional disclosures filed with the appropriate government agencies (such as the U.S. Patent Office).

Phase 3 Qualification Testing completed and published according to plan, results met the specifications and published. All product attributes, such as performance and functionality, characterized and documented.

Complete product design package assembled and archived.

Product, including microcode and documentation, under ECO control.

Parts qualification completed.

All Announcement and First Revenue Ship criteria have been met. Refer to *Pricing and Announcement Committee Manual.*

Engineering Executive Summary updated for the Phase 3 Business Plan.

Assumptions and requirements evaluated since the Phase 2 exit. Significant changes communicated to the Product Team and appropriate approval bodies.

Copies of approved Phase 3 Engineering exit plans submitted to the Product Manager.

4.4.4.2 Phase 3 Activities

Review the completed product for potentially protectable designs or inventions and take appropriate action.

Deliver the product to appropriate test groups as scheduled.

Demonstrate through Qualification Testing that the product has met its specifications and the requirements of Digital and external standards. Qualification Testing includes:

- Regulatory testing and approvals
- Other Digital standard testing or appropriate external testing
- Performance testing
- Design Maturity Testing (DMT)
- Testing in all supported environments
- Reliability Qualification Testing (RQT)
- Software certification and evaluation by applicable software quality test groups (such as SQM/SQG)
- Internal Field Testing
- External field Testing

Obtain approval form the Chief Engineer's Office for any changes to the part numbers approved in Phase 2 (for hardware and systems products only).

Evaluate Qualification Test results for impact on product design.

Begin implementation of the Support Engineering Plan.

Complete external, and country–specific testing of modems and software.

Complete system, cluster, network, and software environment testing (operating system, layered products, applications, customer solutions product). Document results.

Write, review, approve, and publish final test reports.

Support Field Test Sites and poll results according to plan.

Implement appropriate Field Test feedback into the design.

Provide required support to manufacturing process efforts.

Complete, sign off, and archive all internal documentation (such as prints and specifications).

Ensure completion of user and service documentation.

4.4.4.3 Phase 3 Memory Joggers

Have all regulatory approvals been obtained worldwide as planned?

Did you prepare the discrepancy list between "as designed" and "as built" configurations of the product? Have list discrepancies been corrected?

Has Purchasing obtained and approved pricing for purchased parts and signed appropriate purchasing contracts? (To be addressed as appropriate for the specific product; must be complete prior to product announcement.)

Have product documentation and microcode been placed under ECO control?

Can the exact and correct configurations of the total product offering, including software, be determined from currently available documentation?

Have all changes to the product been documented so that the production units can be brought up to the current revision.?

NOTE

> Design Verification Test (DVT) and Reliability Qualification Test (RQT) units must be the same as the production units.

Has each built item been properly labelled? Refer to *DEC STD 178-0 Digital Marking Requirements* for more information.

Have trademarks been used properly?

Have the results of the Phase 2 and Phase 3 testing demonstrated that the product is ready to start Field Test?

Have all parts in the design been qualified? List exceptions.

If used, have serialization, lot coding, and date coding been specified on the drawings?

Will any waivers be requested to allow this product to ship? Are plans in place to promptly close these waivers? Refer to *DEC STD 066-2 Waivers to Digital Design Standards* for more information.

Has a plan been developed to ensure that the tools and processes used to develop the product can be maintained? Have the plans, tools, and processes been archived for future product changes?

Have internal and external Field Testing been completed? Has all appropriate feedback been implemented?

Are there any new ideas developed for which intellectual property rights strategies need to be implemented before product announcement?

4.4.5 Phase 4A – Ramp–Up

Objectives: Transfer engineering responsibility from Development to Support Engineering; support Manufacturing, Sales, and Customer Services in achieving steady–state operations.

4.4.5.1 Phase 4A Exit Criteria

Support Engineering Plan implemented.

Resources and funding in place for ongoing engineering support.

Specified hardware ECO cost responsibility transferred from Development Engineering to Manufacturing. Refer to *DEC STD 100–1C Engineering Change Orders – Financing ECOs to Hardware.*

Assumptions and requirements evaluated since Phase 3 exit. Significant changes communicated to the Product Team and appropriate approval bodies.

Copies of approved Phase 4A Engineering exit plans submitted to the Product Manager.

4.4.5.2 Phase 4A Activities

Evaluate product performance feedback from Quality, Manufacturing, Services, Marketing, and Sales, and take appropriate action.

Provide Engineering support to Manufacturing and Services.

Assemble and transfer a complete design package to Support Engineering.

Transfer product responsibility from Development Engineering to Support Engineering.

Transfer ECO control responsibility from Development Engineering to Support Engineering.

Supply a complete list of risks and open action items to Support Engineering.

Implement Support Engineering Plan and update when appropriate.

Ensure that design tools, database, and processes are operable within Support Engineering.

Participate in the Post–FRS Review to evaluate the introduction process, the Product Team's performance, and the methods and tools used to develop the product.

Obtain approval from the Chief Engineer's Office for any changes to the part numbering scheme for a hardware or system product as a result of:

- ECOs.
- Value Engineering Activity.
- Product enhancements or mid–life kickers.
- Other activities that may cause the need to change or add part numbers to the current product offering.

4.4.5.3 Phase 4A Memory Joggers

Has a complete design package been assembled for transfer to Support Engineering? How did you verify the accuracy of the package?

Has the discrepancy list between the product "as designed" and "as built" been resolved?

Have all manufacturing requirements been met for the transfer of product ECO cost responsibility to Manufacturing?

Have the details of all product data and design tools been documented for Support Engineering? Is Development Engineering in agreement with Support Engineering on this issue?

4.4.6 Phase 4B – Steady–State Operation

Objective (of Support Engineering): Provide the ongoing product support required to maintain steady–state manufacturing and service.

4.4.6.1 Phase 4B Exit Criteria

All product–related material such as design tools, prints, process documents, and ongoing maintenance plans prepared for archiving.

All pending ECOs and remaining open problems dispositioned and documented.

Plans are in place to support the product for the remainder of its useful service life.

Copies of approved Phase 4B Engineering exit plans submitted to the Product Manager.

4.4.6.2 Phase 4B Activities

Evaluate product performance feedback from Quality, Manufacturing, Services, Marketing, and Sales, and take appropriate action.

Ensure all product–related materials been archived according to the corporate vital records retention and archiving requirements. This includes design tools, prints, process documents, and ongoing maintenance plans.

Provide ongoing Engineering support.

Evaluate whether a Valued Engineered product is a good investment for Digital.

Obtain approval from the Chief Engineer's Office for any changes to the part numbering scheme for a hardware product as a result of:

- ECOs
- Value Engineering Activity
- Product enhancements or mid–life kickers
- Other activities that may cause the need to change or add part numbers to the current product offering

Look for ways to maximize results (to do better than planned).

Provide input to the Product Phase Down Plan.

Review all functional Product Phase Down (PPD) Plans including Product Management, Engineering, Manufacturing, Marketing, Sales, and Services.

4.4.6.3 Phase 4B Memory Joggers

Have all pending ECOs or design problems been closed or plans established for their management?

Has a plan been developed for ongoing support of the product after it has been phased down?

4.4.7 Phase 5 – Product Retirement (Service Continues)

Objective: Provide ongoing Engineering support and execute the product retirement plans agreed to in Phase 4B.

4.4.7.1 Phase 5 Activities

Phase 4B Phase Down Plan implemented.

All Support Engineering activities identified in the Product Phase Down Plan completed. Ongoing Engineering Support capability in place for the service life of the product.

All pending ECOs dispositioned and documented.

A final open problems package documented and archived.

Support Engineering executes its elements of the Product Phase Down Plan.

Determine whether or not the product, if software, is a candidate for the DECUS Public Domain Library.

4.5 REQUIRED ENGINEERING DOCUMENTS

The overviews and outlines contained in this section serve as guidelines for the creation of the plans and documents used by the Engineering Manager in support of the Phase Review Process. The content, style, and scope of the plans may vary for hardware and software products and across Engineering groups. The outlines present the minimum requirements for Engineering plans and documents submitted for Phase Exit approval.

This section contains outlines for the following Engineering documents:

- Alternatives and Feasibility Study
- Engineering Development Plan

NOTE

Online versions of these outlines are available as a VAX DOCUMENT .SDML file and as an ASCII file from Standards and Methods Control. Use the following specifications to obtain the outlines for the Engineering Plans.

JOKUR::PHASE_REVIEW:ENGINEERING_PLANS.SDML
JOKUR::PHASE_REVIEW:ENGINEERING_PLANS.TXT

Contact JOKUR::SMC with problems copying these files.

4.5.1 Alternatives and Feasibility Study

OVERVIEW

Purpose:

The Alternatives and Feasibility Study quantifies the alternatives for providing target market products, analyzes the tradeoffs for their development, addresses the total life cycle cost to Digital.

Desired Characteristics:

- Identification of alternatives that satisfy product goals and requirements using existing Digital products (available concurrently or in development) or externally developed components and products.
- Analysis of tradeoffs for product development with quantified alternatives for providing target–market–specific product(s) that address the total life cycle cost to Digital.
- Presentation of evidence that clearly demonstrates the technical feasibility of the selected alternative.
- Identification of methodology required to develop the product within the constraints of cost and schedule.
- Indentification of product development interdependencies.

Audience:

- PBU or sponsoring organization
- Product Team

ALTERNATIVES AND FEASIBILITY STUDY OVERVIEW (continued)

Who is Responsible:

- The Engineering Development Manager with inputs from the Product Team.

When Required:

- The study is conducted during Phase 0, the Strategy and Requirements stage of the product. The results are distributed prior to the Phase 0 Exit review.

Relationship to Other Plans:

- Phase 0 Business Plan
- Product Requirements Document
- Market Requirements section in the Marketing Plan
- Preliminary Functional Specification
- Preliminary Engineering Development Plan

Where Recorded:

Product Archives in the PBU or sponsoring organization.

ALTERNATIVES AND FEASIBILITY STUDY OUTLINE

1.0 EXECUTIVE SUMMARY

1.1 GOALS AND REQUIREMENTS
1.2 RECOMMENDED ALTERNATIVE(S)
1.3 IMPACT TO TECHNICAL FEASIBILITY
1.4 IMPACT TO LIFE CYCLE COST AND Schedule

2.0 ANALYSIS OF SELECTED ALTERNATIVES AND TECHNICAL FEASIBILITY

2.1 ALTERNATIVE DEVELOPMENT STRATEGIES WITH LIFE CYCLE COST AND SCHEDULE IMPACT STATEMENTS FOR EACH STRATEGY
2.2 IMPACT OF OTHER DEVELOPMENT EFFORTS (CURRENT/FUTURE)

- 2.2.1 Advanced Development
  - a. Current
  - b. Future
- 2.2.2 Hardware Development
  - a. Current
  - b. Future
- 2.2.3 Software Development
  - a. Current
  - b. Future
- 2.2.4 Tools and Process Development
  - a. Current
  - b. Future

2.3 IMPACT ON TARGET DESIGN FREEZE SCHEDULE
2.4 IMPACT ON SYSTEM INTEGRATION TESTING (Refer to CPT in Glossary.)
2.5 IMPACT ON MANUFACTURING
2.6 IMPACT ON SERVICE REQUIREMENTS
2.7 IMPACT ON TARGET PRODUCT AVAILABILITY SCHEDULE
2.8 IMPACT ON TOTAL LIFE CYCLE PRODUCT COST TO DIGITAL

3.0 OVERVIEW OF PROJECTED LIFE CYCLE COSTS

3.1 PRODUCT DEVELOPMENT/SUPPORT THROUGH PHASE 5

- 3.1.1 Hardware/Firmware
- 3.1.2 Software
- 3.1.3 Systems Integration
- 3.1.4 Engineering Services
- 3.1.5 Tools, Documentation, Testing, and Qualification
- 3.1.6 Process Technology (Refer to CPT in Glossary)
- 3.1.7 Manufacturing
- 3.1.8 Customer Services
- 3.1.9 Marketing
- 3.1.10 Sales
- 3.1.11 Other

4.0 PROJECT INTERDEPENDENCIES

Elements affecting implementation of selected alternative(s):

4.1 OTHER PRODUCTS OR PROGRAMS

- 4.1.1 Internal to Digital
- 4.1.2 External to Digital – Competitors
- 4.1.3 External to Digital – Vendors

4.2 RESOURCES

- 4.2.1 Machines
- 4.2.2 Tools
- 4.2.3 Processes
- 4.2.4 Software
- 4.2.5 Hardware

4.3 ARCHITECTURE

- 4.3.1 Hardware
- 4.3.2 Software

4.4 TECHNOLOGY

- 4.4.1 Design
- 4.4.2 Tools
- 4.4.3 Process

4.5.2 Engineering Development Plan

OVERVIEW

Purpose:

The Engineering Development Plan is an operational plan that manages the product development effort. The plan is used to coordinate work from each of the functional groups, to demonstrate where overall project reviews will occur relative to functional group efforts, and to evaluate progress of the ongoing effort.

Desired Characteristics:

- A list of the sources of data and assumptions used to create the plan.
- A list of major issues and risks identified in Phase 0 that are critical to the product's development.
- The major tasks of each functional organization involved in the product's development.
- The detailed commitments, schedules, and costs of all functional groups responsible for achieving the project objectives.

Audience:

- PBU or Sponsoring Organization, Product Manager, Marketing, Sales, Manufacturing, CSSE, Development Engineering, and Support Engineering.
- Other required support organizations, such as Test and Quality Groups.

Who is Responsible:

- Engineering Manager with inputs from Product Manager, Marketing, Sales, Manufacturing, CSSE, Support Engineering and designated representatives from groups needed to achieve project objectives.

ENGINEERING DEVELOPMENT PLAN OVERVIEW (continued)

Who Approves the Plan:

- Product Business Unit (PBU) or sponsoring organization Management

When Required:

- The Engineering Development Plan is prepared during Phase 1, Planning and Preliminary Design of the product. The completed document is distributed prior to the Phase 1 Exit. A preliminary version of this plan is created in Phase 0. The format and content of the preliminary plan are governed by the PBU or sponsoring organization.

Relationship to Other Activities:

- Phase 0 and 1 Business Plans and subsequent updates
- Product Requirements
- Marketing Requirements
- Alternatives/Feasibility Study
- Phase 0 Preliminary Engineering Development Plan
- Impact and requirements from Manufacturing, Sales, and Service
- Phase 0 Preliminary Functional Specification

Where Recorded:

- Product Business Unit (PBU) or sponsoring organization

ENGINEERING DEVELOPMENT PLAN OUTLINE

1.0 EXECUTIVE SUMMARY

This section provides a broad and concise description of the proposed product. This section shall not duplicate the executive summary sections of the other functional plans, but shall provide the reader with a more concise explanation of the essential information required to judge the business and market potential of the product. The executive summary shall include:

- Product Goals
- Product Description
- Design Strategy and Tactics
- Product Configurations
- Schedule of Product Deliverables
- Technical Risks and Dependencies
- Critical International Concerns
- Human Resource Requirements
- Issues Without a Clear Resolution Process
- Budget Requests/Project Descriptions

2.0 PRODUCT GOALS

Describe the major goals for the product considering each of the major areas: Engineering, Manufacturing, Marketing, Sales, International requirements, Quality and Customer Satisfaction, Financial, and Customer Services. Include descriptions of the primary goals for the product, the opportunity being addressed or problem that is being solved, benefits to prospective customers, product replacement goals, target First Revenue Ship (FRS) date, projected product life cycle costs, schedule, and international requirements. Address the following:

- What is the primary goal for the product? Does it conform to the Corporate and Business Unit Product Strategy?
- Discuss plans to match user needs, requirements, and expectations. What problem does the product solve?
- How is the product positioned, internally and against the competition? Does it replace an existing product? Is it part of a larger program?
- How will the development results be measured against product requirements? What metrics will be used to determine the overall success of the product?

- What are the quality goals for the product? (For example, product quality, problem-free installation, customer satisfaction, user availability, reliability.)

3.0 PRODUCT DESCRIPTION

Provide the product name (spell out acronyms), a description of its functionality, its place in a family of products (if appropriate), and other details that describe to the reader the product, its functions, target customers, and position relative to other Digital products and the competition.

- What is the product? (Discuss physical and functional characteristics.)
- What are its primary functions? How do these functions satisfy the critical market success factors and customer requirements?
- What type of customer/application environment is the product targeted for (multiuser, banking, educational, desktop, high user availability, secure system)? What physical characteristics (footprint and configurations) are planned to satisfy the needs of these environments?
- With which operating systems or hardware configurations will this product be used?
- Is this product part of a larger program? If so, identify the program.
- What are the additional requirements and plans needed for this project (such as Test/Verification Plans, Qualification Plans, and/or Documentation Plans)?

4.0 DESIGN STRATEGY AND TACTICS

Describe how you are going to achieve the product's goals and what you will do to implement this strategy. Describe the design alternatives that were chosen; the technology, tools, and methodologies that will be used; and the functionality that will be provided. Map tactics into projects in the development cycle.

- Is this a make or buy product? For buyout , or partial buyout products, indicate the nature and state of the vendor(s) relationship with Digital. Provide a description of the terms and conditions of expected or negotiated contracts.
- Summarize the alternatives that were addressed when selecting this design approach. Why is the proposed design the best approach?
- Highlight unusual or problematic areas with the design.

ENGINEERING DEVELOPMENT PLAN OUTLINE (continued)

- Discuss exceptions to current policies and procedures (list reasons). For example: "The product will not satisfy international requirements because" ... (and list the specific requirements).
- What functionality or features will make this product a clear price/performance leader? What functionality is required? What functionality are you going to deliver?
- Discuss critical high–risk packaging requirements. Such as, hi–density chips, compact footprint cabs, unusual module/system configurations. How do these design requirements impact other functions on the Product Team (manufacturing process, service skills, engineering design tools)?
- Summarize plans for Phase 2 and Phase 3 testing. Describe the tests, responsible organizations, schedules, and quantities of product required.

  For each of the major types of testing (internal, external and qualification), answer the following questions:

  — What is the overall objective of this portion of testing?

  — Which verification tasks are to be carried out in these tests?

  — What is the sequence of testing activity?

  — What is the expected length (elapsed time) for each test activity?

  — What will not be tested and why?

  — What are the criteria that must be met for success of each test activity?

  — Where/how will the results of each test activity be reported?

5.0 PRODUCT CONFIGURATIONS

Describe how the product will be packaged. How many variations will be presented? Address customer quality, product performance, reliability, availability, usability, and other important features that are satisfied by these configurations. For early product versions, which may not fully satisfy required market functionality, describe the strategy that will be used to ultimately satisfy these requirements. Define the number of alternate product forms to be provided and their purposes.

6.0 SCHEDULE OF PRODUCT DELIVERABLES

List major milestones for the development of this product by Phase. Milestones are the major events through which a product must pass to ensure its success. These are distinct from, but will likely overlap with, schedules and major phase exits. Include activities required of other groups to develop and deliver this product. For each plan update, indicate progress against the Phase 1 plan and document any significant deviations from planned milestones.

- List the key milestones for this project.
- Discuss what is being done, when, and by whom for each Phase.
- Define additional milestones that have been added to the approved plans.
- Justify major milestones that have been deleted or omitted from the approved plans.
- Identify deliverables and schedules by Phase for each functional organization participating in this effort, including subassembly development in power and packaging, software development, system component development.
- Confirm that commitments are valid and achievable.
- Define metrics for product success. For example, how will results be measured against Phase 0 requirements and Phase 1 Plans?
- Define the problem escalation process that will be used to resolve major team/product related issues.

7.0 TECHNICAL RISKS AND DEPENDENCIES

Identify the technical risks to success and the consequences if Digital does not develop this product. Also, identify what primary factors must be addressed to ensure the market success of this product. Explain all other important factors that pose a risk, or factors that determine the product's success (basic assumptions customers, economic factors, new materials, process requirements, internal support, and technology). Provide a description of the identified risks and dependencies.

- Address all dependencies within and outside of the immediate scope of this project.

NOTE

Dependencies include functions of projects that are required for completion of this project.

- Identify other projects that are dependent on this project for completion.
- State any significant risks of the project, such as previously unused parallel development of product and process technology.
- Describe contingency plans to manage the risks.
- List outstanding issues in this plan by reference number, individual, organization, and expected/required completion date.

8.0 CRITICAL INTERNATIONAL CONCERNS

Discuss areas that need to be addressed to make this product successful in Digital's strategic country markets.

- Will the product be exportable under current Export and Trade Laws?
- Are there specific requirements that must be satisfied in order for the product to be sold in certain countries (such as language, translation, symbols, and test certifications)?

NOTE

The International Engineering Development Group (IED) will provide an Internationalization Plan, and ensure that commitments, resources, and funding are in place to define and implement internationalization requirements. See Glossary for Internationalization Plan definition.

9.0 HUMAN RESOURCE REQUIREMENTS

- Identify the skill type, level, and quantity required to achieve the requirements of this plan.
- What are the alternatives if these resources are not available?

10.0 ISSUES WITHOUT A CLEAR RESOLUTION PROCESS

- What areas of this plan have been identified as required to the success of the project, but have not been able to obtain commitment or support?
- Are there major disagreements among Product Team members relative to the proposed product characteristics and schedule?
- Are there areas of this plan that you feel require Senior Management decisions, such as major deviation from strategy and cross–organizational disputes?

11.0 BUDGET REQUESTS/PROJECT TASKS AND ESTIMATES

Develop a comprehensive set of project information and cost estimates. The intent is to provide reviewers with the information required to objectively determine whether the project is a good investment.

- List all project related costs by Phase, including direct/indirect labor, capital, facilities, travel, training, and technology. See *DEC STD 130*.

NOTE

> The Engineering Manager should work closely with the Finance representative from the PBU or sponsoring organization to develop this information.

- Describe development and verification tasks and time to be completed in order to achieve goals and characteristics listed in the product specification (minimum of one task for each goal or characteristic identified in the product functional specification).
- List of individual(s) or group expected to complete each task.
- Provide a matrix of tasks associated with the appropriate goals and characteristics (each development task should have an accompanying verification or qualification task).

ENGINEERING DEVELOPMENT PLAN OUTLINE (continued)

11.1 ESTIMATES (Development Requirements)

- Identification of method(s) used for estimation. For example: How did you arrive at these estimates, assumptions and actual responses?
- Estimate of man–hours and cost by task.
- Development schedule based on estimates from each task and available resources. This forms the basis for the overall Development schedule.

11.2 RESPONSIBILITIES

List all project team members and their responsibilities. Include a description of the team organization and why it is likely to be successful.

- Define roles and responsibility of all project resources
  - — Product Team
  - — Development Team (Engineering resources assigned to this project)
  - — Qualification Team
  - — Resources external to the Engineering Development Team
- List resources with prime responsibility for each task or function in the Development Plan.

11.3 DEVELOPMENT RESOURCES

- Describe resources required for each development and verification task (tools, machines, and processes).
- Identify required machine resources.
- Identify software required to support machine resources.
- Identify type of machine access needed (timeshare, standalone).
- Identify amount of machine time and capacity required (such as the number of computes required for a simulation program).
- Develop planning chart to plot availability of required resources by quarter.
- Identify new and prototype software or hardware required.
- Identify required but uncommitted resources.

11.4 STAFFING

- Personnel required (skills, experience)
- How many? Full time? Part time? Contract?
- Staffing by quarter chart (when they are needed)
- Training required (when, how, address learning curve)

11.5 TOOLS AND METHODOLOGIES (Refer to CPT in Glossary and Engineering Memory Joggers)

- What design tools or process steps must be available in the current and next phase?
- What support will be in place while you are using these tools?
- Are there any tools or processes in development for use beyond the next phase? What is their status?

- Travel required to support this project, such as interplant or vendor.

11.7 DEPENDENCY MANAGEMENT

- Define the methods used to maintain control and measure status of each project dependency.

11.8 DESIGN REVIEWS

- Responsible individual(s).
- Schedules.
- The method to obtain and implement feedback from the design review.
- Final reviewers.

NOTE

The design review group should include system and product experts (both hardware and software), the support engineering function, and the organizations that are involved in the development effort.

11.9 DOCUMENTATION PLAN OUTLINE

Overview

- Documentation Requirements
- Hardware Documentation Strategy
- Software Documentation Strategy
- Users Manuals
- Users Guides
- Educational Services Documentation
- Other Documentation Activity (SPD updates, product brochures)

Plan Milestones

Production and Printing Requirements

- Production
- Printing and Distribution

11.10 PROJECT SECURITY

Define data security and recovery measures.
Define archive plans for all project and design information.

11.11 POST-FRS PROJECT REVIEW

Define the schedule, resources, and method that will be used to capture and communicate project information back into the development system after the project is complete.
Provide an assessment of the feedback mechanism used.

11.12 DOCUMENT RETENTION/CHANGE CONTROL

- Define the mechanism to update project documents and to centrally locate documentation during and after the project.
- Identify the organization committed to archive, reproduce, and update documentation on an ongoing basis.

12.0 RELATED DOCUMENTS

- Marketing Requirements Document
- Product Requirements Document
- Alternatives/Feasibility Study
- System Specification
- Product Functional Specification
- Support Engineering Plan
- Phase 0
  - Business Plan
  - Market and Product Requirements
  - Impact and Requirements from Sales, Manufacturing, and CSSE
  - Preliminary Engineering Development Plan
  - Preliminary Functional Specification

4.6 REFERENCE MATERIAL FOR PRODUCT DESIGN

EL–00012–02	*DEC STD 012–2 Unified Numbering Code for Part Identifier Class Codes and Related Document Identifiers*
EL–00012–04	*Unified Numbering Code – Software Distribution Center Part Numbering Conventions*
EL–00038–00	*DEC STD 038–0 System Evaluation of New Products – General*
EL–00038–01	*DEC STD 038–1 System Evaluation of New Products – Software*
EL–00038–02	*DEC STD 038–2 System Evaluation of New Products – Hardware*
EL–00060–00	*DEC STD 060–0 Design of Hardware Products to National and International Regulations and Standards, Policies, and Responsibilities*
EL–00060–01	*DEC STD 060–1 Design and Certification of Hardware Products to National and International Regulations and Standards – Specific Requirements*
EL–00066–00	*DEC STD 066–0 Digital Design Standards Required for the Design of Digital Products*
EL–00066–01	*DEC STD 066–1 The Roles and Responsibilities of Technical Domains in the Design and Development Process in Digital*
EL–00130–00	*DEC STD 130–0 Product Business Plans: Content Requirements and Format Guidelines*
EL–SM498–00	*Producing International Products*
EL–EN522–00	*Digital Qualification Process Manual*
EL–CPPAC–00	*Pricing and Announcement Committee – Corporate Policies for Product Pricing, Announcement, and First Customer Ship*
EL–CP596–00	*Top 100 Process Overview Manual*
EL–ENGRS–0M	*Internal Guide to Digital Organizations*

Chapter 5

MANUFACTURING

5.1 PURPOSE

From Manufacturing's perspective, the Phase Review Process is a mechanism that, over the life cycle of a product, provides a media for worldwide cross–functional communication, process development, synchronization, project implementation, tracking, and readiness assessment. This process ensures that:

- Manufacturing builds products using verifiable processes that consistently satisfy the perceived demands of the customer.
- The product is manufacturable, reproducible, reliable, and cost effective.
- Manufacturing has the worldwide capability to meet customer demand as defined by marketing forecasts.
- Manufacturing has the ability, during and beyond the initial phase of product introduction, to rapidly achieve:
  - Timeliness of scheduled commitments
  - Competitive cost opportunities, independent of volume
  - Competitive quality opportunities, independent of volume
- Manufacturing can manage Product Phase Down, and optimize customer satisfaction, return on assets, and field service requirements.

5.2 FUNCTIONAL RESPONSIBILITIES

This section describes the following areas of responsibility in the Manufacturing function of the Phase Review Process:

- Product Business Unit Manufacturing (PBUM)
- Responsibilities to the Phase Review Process
- Required Documents
- Manufacturing Systems Program Manager (MSPM)
- Key Manufacturing Project Functions
- Manufacturing Phase Review Manuals

5.2.1 Product Business Unit Manufacturing (PBUM)

In support of Digital's product base, Manufacturing has established PBUMs. These units are responsible for defining overall manufacturing business objectives and strategy based on the competitive environment and the goals and objectives of the PBUs. Responsibilities include:

- Communicating strategy to Manufacturing Systems Program Managers (MSPMs), so that they can ensure inclusion of and synchronization to product life cycle goals and objectives.
- Interfacing with manufacturing plants worldwide to ensure that business strategies are understood and implemented, and that future business or technology trends are comprehended and incorporated into long–range plant planning.
- Acting as a collaborative partner with PBUs, Product Management, Marketing, Sales, Services, customers, vendors, areas, volume plants, and PBUM groups.

5.2.2 Manufacturing Responsibilities to the Phase Review Process

The major Manufacturing responsibilities to the Phase Review Process are as follows:

- Develop a worldwide, competitive, manufacturing capability for the product and all of its components (hardware, software, and documentation), from product inception to product phase down.
- Develop a worldwide organizational commitment over the product life cycle that is proactive and based on business excellence and performance concepts.
- Interface with the Product Team to define manufacturing project goals and objectives: resolve issues relating to manufacturing; and manage the product through its life cycle, consistent with agreed product milestones. The Product Team usually consists of Product Management, Marketing, Manufacturing, Engineering, Product Support Engineering, Customer Services, and Sales.
- Publish a Product Impact Statement (from a Manufacturing perspective) in Phase 0 and ensure that the impact on existing or proposed worldwide manufacturing technologies, processes, resources, space, and costs is understood and dealt with by the Product Team and other responsible parties.
- Develop manufacturing concepts, strategies and plans (both strategic and operational) that define scope, direction, magnitude, and required commitments to ensure the product's success over its life cycle. These plans must be consistent with PBU/PBUM goals and objectives.
- Provide a formal implementation and verification process of checks and balances against Phase 0 through Phase 5 criteria that ensure manufacturing readiness and competitiveness.
- Review and influence design–related decisions (hardware and software), and ensure that the final product can be consistently produced over extended periods of time at a competitive cost.
- Convert manufacturing–defined concepts and strategies into highly–efficient, practical process solutions consistent with New Product Start–Up (NPSU) milestones, First Revenue Ship (FRS) milestones, and company goals for customer satisfaction.

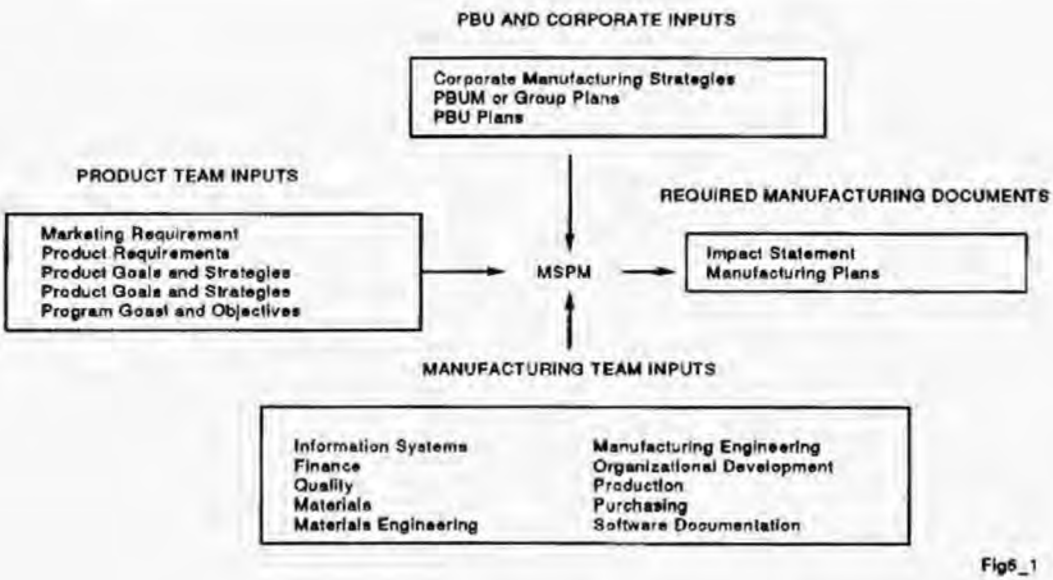
- Develop worldwide component, module, subassembly, peripheral, software, documentation, and cabinet–level sourcing and distribution processes consistent with manufacturing process technologies and competitive business excellence requirements.
- Define, plan, and manage life cycle budgets, cost of goods sold, and manufacturing assets over the product life cycle.
- Ship product to meet customer demand and Sales forecast.
- Manage product evolution through ramp–up, steady–state, and phase–down to ensure that customer satisfaction goals are:
  - Efficiently achieved.
  - Maintained over extended periods of time.
  - Continuously improved relative to cost reduction and performance enhancement through constant and systematic processes.
- Develop and manage product phase down, according to commitments.

5.2.3 Generation of Required Manufacturing Documents

The generation of Manufacturing documents requires the full integration and synchronization of various plans produced at all levels in the Corporation.

Figure 5–1 describes a typical information flow of information and the various inputs require consideration when the MSPM develops required Manufacturing documents.

Figure 5–1: Generation of Required Manufacturing Documents



5.2.4 Manufacturing Systems Program Manager (MSPM)

The MSPM represents and manages Manufacturing's interests on the Product Team, setting manufacturing goals and objectives based on product and Corporate strategies and guidelines. The MSPM also ensures that manufacturing plans, issues, and inputs are published and worked to resolution.

NOTE

> The term MSPM may be replaced with Program Manager, especially in groups that manage saleable peripherals, communication devices, and software.

Further responsibilities of the MSPM include management and orchestration of key manufacturing business and technical groups and functions, and coordination, synchronization, and completeness of deliverables as defined for the project.

5.2.5 Key Manufacturing Project Functions

Figure 5–1 shows the organizations responsible for life cycle management. Each function provides representatives who, with the MSPM, form the Manufacturing Team. This team delivers what is required from Manufacturing to the Product Team.

Each representative is responsible for developing plans; coordinating activities and deliverables for their specific function; and ensuring that product business goals and objectives are understood, implemented, and achieved.

5.2.6 Manufacturing Phase Review Manuals

The Manufacturing Phase Review Manuals listed below describe the responsibilities of the individual manufacturing functions as they relate to product life cycle management. Each function's operations, deliverables, tasks, and actions are described in relationship to Phase Exit requirements.

DEC STD 084 Process and Technology Phase Review Procedure Standard and Workbook	EL-00084-00
Administration Policies and Procedures – Product Phase Down Policy	EL-MF028-00
Manufacturing Systems Program Manager (MSPM) Guide	EL-MF356-00
Manufacturing Finance Phase Review Guidelines	EL-MF356-01
Information Systems Phase Review Guidelines	EL-MF356-02
Corporate Materials Architecture New Products Module Material Phase Review Process	EL-MF356-04
Manufacturing Order Administration Phase Review Guidelines	EL-MF356-05
Customer Satisfaction/Quality Phase Review Guidelines	EL-MF356-06
Phase Review Production Guidelines	EL-MF356-07
Materials Engineering Domain Phase Review Guidelines	EL-MF356-08
Manufacturing Product Phase Down/End-of-Life Guidelines	EL-MF540-00

The above manuals serve as guidelines for Phase Review execution and focus, and may change depending on the type or form of product being introduced.

The manuals are organized to define:

- What tasks and deliverables the specific function actually performs.
- What the function needs from other groups to execute deliverables.
- When the function requires information about their role, relative to life cycle management.
- When the function requires a guideline from which to execute deliverables.
- How the deliverables are timed to synchronize with Phase Exits.

5.3 MANUFACTURING ACTIVITIES AND DELIVERABLES

Figure 5–2 shows the major activities and deliverables of the Manufacturing function over the product's life cycle.

Figure 5–2: Manufacturing Activities and Deliverables

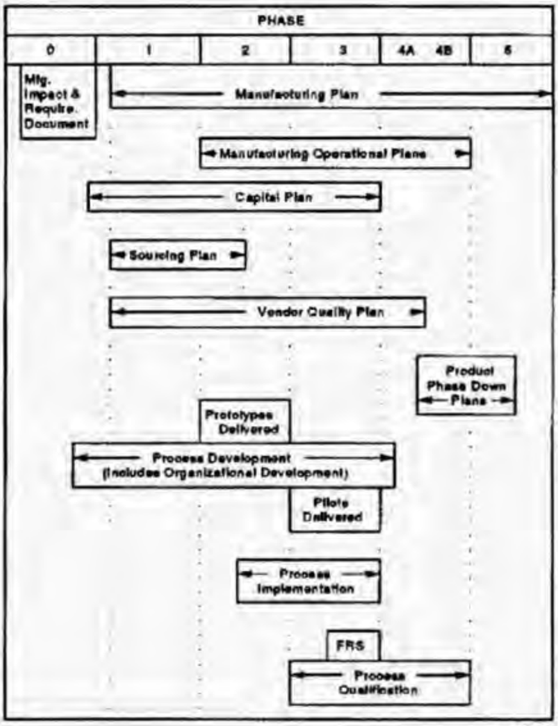


Fig5_2

5.4 EXECUTING AND EXITING EACH PHASE

Each phase in the product's life cycle provides a mechanism for the systematic review of proposals, plans, and results in a manner that allows for controlled funding, resource allocation, and project approval.

For each phase in this chapter, there is a list of Exit Criteria and supporting Activities for the MSPM. Their purpose is to stimulate the thought process and surface issues as early as possible in each phase.

As each phase is exited, the focus of Manufacturing changes, as is reflected in the definitions and deliverables of the Activities and Exiting deliverables required of the Manufacturing Team. It is the responsibility of the MSPM to ensure that deliverables are achieved and acceptable to both Manufacturing and the Product Team. When deliverables are deemed unacceptable, the MSPM is expected to work problems to resolution.

5.4.1 Phase 0 – Strategy and Requirements

Objective: A Manufacturing Product Team evaluates the product as conceived, provides guidance to Engineering regarding manufacturability issues, and studies the possible impact on manufacturing technology and worldwide manufacturing plants.

The major deliverable of this phase is a Manufacturing Impact and Requirements Document. Each team member is responsible for delivering their functional plan or input to the MSPM at each Phase.

5.4.1.1 Phase 0 Exit Criteria

Manufacturing Impact and Requirements Document written, reviewed, approved, and published.

Impact and Requirements Document Executive Summary included in the Phase 0 Business Plan.

Potentially protectable manufacturing inventions and developments identified. A Legal Protection Strategy developed and clearance for the product or process name obtained.

Copies of approved Phase 0 Manufacturing exit plans submitted to the Product Manager.

5.4.1.2 Phase 0 Activities

The Product Business Unit Manufacturing (PBUM) group identifies the Manufacturing Systems Program Manager (MSPM).

Create the Manufacturing Team from all Manufacturing functions, including Finance, Production, Quality, Organizational Development, Point of Manufacturing (POM) focus, software, and header contact.

Evaluate product fit in the Corporate Manufacturing business strategy and define the impact to existing products and manufacturing processes.

Develop concepts for practical manufacturing solutions based on the Corporate Manufacturing business strategy.

Provide a competitive analysis of similar computer manufacturing businesses and identify and evaluate alternatives for manufacturability.

Identify potentially protectable manufacturing inventions and developments (Legal Protection Strategy).

Ensure that the Manufacturing Team is available to work with Design Engineering, if needed.

Provide Purchasing services to Engineering for component and buyout products.

Estimate Manufacturing Program costs.

Each Manufacturing Team member writes their portion of the Impact Requirements Document.

Complete the Manufacturing Impact and Requirements Document.

Set major Point of Manufacturing (POM) milestones.

5.4.2 Phase 1 – Planning and Preliminary Design

Objective: Create a comprehensive Manufacturing Plan.

The Manufacturing Plan defines: Strategies, goals and objectives; budgets, capital spending and resource needs; and where, how, and when the product will be available for qualification and customers through First Revenue Ship (FRS) and volume ramp.

5.4.2.1 Phase 1 Exit Criteria

Product assumptions and functional requirements evaluated since the Phase 0 Exit. Functional plans updated and significant changes communicated to the Product Team.

Manufacturing is committed to supporting the product.

Manufacturing Plan written, reviewed, approved, and published.

Executive Summary of the Manufacturing Plan (developed by the MSPM) available for the Phase 1 Business Plan.

Copies of approved Phase 1 Manufacturing exit plans submitted to the Product Manager.

5.4.2.2 Phase 1 Activities

Participate in defining product goals and objectives.

Identify major tasks, deliverables, and interdependencies through First Revenue Ship (FRS) and volume ramp.

Complete the Manufacturing Team from all manufacturing functions, including Finance, Information Systems, Manufacturing Engineering, Materials, Production, Quality, Organizational Development, POM focus, software manufacturing, and header contact.

Define manufacturing capability based on the available preliminary design.

Contact the Law Department to review all *new* aspects of the proposed product for intellectual property content. File applications for legal protection for potentially protectable manufacturing inventions and developments, and the product or process name.

Define methods for managing project deliverables over the product's life cycle.

For Software products, the Software Distribution Center (SDC) new products planner creates a preliminary New Products Form (NPF).

Define worldwide manufacturing process strategies and develop effective process technologies consistent with product introduction schedules.

Develop a sourcing strategy, including plant, work force, ramp–up, and assessment of New Product Start–Up (NPSU) team phase–out impact.

Provide a financial budget.

Finalize manufacturing goals and objectives for customer satisfaction and provide predicted specifications/measurements for manufacturing processes.

Publish preliminary Vendor Qualification Plan.

Develop preliminary Capital Plan.

Support Engineering on the preliminary Verification Qualification Plan.

Establish requirements for approval of the Support Engineering Plan.

Annotate the Manufacturing Impact and Requirements Document with Engineering commitments.

Obtain appropriate Manufacturing approvals.

Provide the Product Manager with the estimated number of units required to support Phase 2 and Phase 3 Manufacturing activities.

Provide detailed input to the Product Team on Phase 2 and Phase 3 Build Plans, which are included in the Phase 1 Manufacturing Plan.

Assess Manufacturing's ability to meet the requirements of the Phase 1 Manufacturing Plan through a major review.

5.4.3 Phase 2 – Implementation and Design

Objective: Convert Manufacturing Plan requirements into physical deliverables, including product hardware and software. These deliverables form the foundation of worldwide manufacturing processes.

5.4.3.1 Phase 2 Exit Criteria

Product assumptions and functional requirements evaluated since the Phase 1 Exit. Functional plans updated and significant changes communicated to the Product Team.

Manufacturing Plan Executive Summary available for the Phase 2 Business Plan.

Updated Manufacturing Plan with full operational details and changes.

FRS readiness assessment completed according to plan.

Bill of Materials (BOMs) completed for hardware products.

Functional production prototypes delivered to Engineering.

Copies of approved Phase 2 Manufacturing exit plans submitted to the Product Manager.

5.4.3.2 Phase 2 Activities

Manage manufacturing tasks and deliverables and ensure synchronization to business and project goals.

Finalize manufacturing process technologies and clearly define capability (statistically and operationally).

Execute Legal Protection Strategy.

Verify manufacturing technology performance according to design specification; have well defined upper and lower tolerances that can be statistically measured.

Evaluate Engineering Qualification Plans and ensure linkage to Manufacturing goals for process, reliability, and customer satisfaction.

Finalize the Manufacturing Process Qualification Test (PQT) Plan, including the Process Verification Test (PVT) Plan.

Deliver Engineering prototypes.

NOTE

> From a qualification standpoint, prototypes should incorporate a full set of components that meet specification; components that do not meet specification should be identified. Prior to major component purchases, the specification should be changed or the appropriate component upgraded or replaced.

Train key personnel to support process start–up and NPSU technical core team phase–out.

Publish a Manufacturing Sourcing Plan early in this phase.

Evaluate source plants for compliance with quality expectations.

Publish a Manufacturing Operations Plan update. Provide operational details at start–up in volume plants.

Begin vendor, component, and process qualification.

Finalize fit–up for prototype build, based on process technologies to be incorporated in the manufacturing process.

Deliver production built prototypes.

Build and deliver pilots for Engineering qualification.

Publish product transfer cost, by year, sensitized to volume requirements.

Create the Manufacturing BOM for hardware products and update the NPF for software products.

Verify that Manufacturing builds the product to the current revision.

Complete and obtain approval for the Capital Plan.

Complete Point of Manufacturing (POM) plans.

Support Engineering on the final Verification Plan.

Review the design to ensure that committed manufacturing requirements have been implemented.

Each Manufacturing Team member writes their portion of the Manufacturing Plan.

Conduct a Manufacturing FRS Readiness Review.

Identify those components that do not meet specification, and apply for a waiver, if necessary.

5.4.4 Phase 3 – Qualification

Objectives: Commence building product for First Revenue Ship (FRS). Complete worldwide process fit–up. Verify worldwide process capabilities against volume ramp requirements.

5.4.4.1 Phase 3 Exit Criteria

Assumptions and functional requirements evaluated since the Phase 2 Exit. Functional plans updated and significant changes communicated to the Product Team.

Phase 3 Manufacturing Plan written, reviewed, approved, and published.

Manufacturing Plan Executive Summary submitted for the Phase 3 Business Plan.

Copies of approved Phase 3 Manufacturing exit plans submitted to the Product Manager.

First revenue units shipped.

Software Distribution Center (SDC) new product planner ensures that the NPF has been approved.

5.4.4.2 Phase 3 Activities

Quantify process verification against defined specifications and quality predictions.

Qualify source plants and guarantee product availability.

Complete Manufacturing worldwide process fit–up and verify manufacturing process capability against predictions and specifications.

Maintain synchronization of build plans.

NOTE

> Plants should not use different processes unless the impact of the process difference and control of this difference has been statistically determined.

Commence worldwide Manufacturing Process Qualification using required processes for ramp and volume production.

Evaluate the Manufacturing impact of ongoing results from the design engineering qualification process.

Debug worldwide manufacturing processes and ensure that complete measurement systems and process controls are in place and operational.

Place all vendors and component parts on a Qualified Vendor List (QVL).

Complete training of personnel to support manufacturing ramp.

Ensure that the Manufacturing data collection process is in place and operational.

Ensure that the documentation to support the manufacturing process is released and available.

Participate in the implementation of the Support Engineering Plan.

Verify that Manufacturing is building product to the current revision.

Check the first pilot product for accuracy against the current revision.

Serialize all units according to product design documentation.

Verify completeness of distribution and order processing.

Conduct an independent readiness review and supply feedback.

Close all action items identified in the Phase 2 FRS readiness review.

Provide ongoing support for the Engineering qualification process.

Ensure that Point of Manufacturing (POM) menus are ready.

Ensure that POM requirements have been implemented.

Complete the customer audit plan.

Plan to participate in a Post–FRS Review, which usually occurs one month after FRS. For this review, document:

- Actual accomplishments versus Phase 1 goals and objectives
- What the team did well, and what areas need improvement
- Recommendations

Each Manufacturing Team member updates their portion of the Phase 3 Manufacturing Plan.

5.4.5 Phase 4A – Ramp–Up

Objectives: Replicate product based on design specification; ramp–up to steady–state volume with focus on customer demand and timely delivery.

Specify the criteria for transition of ECO control responsibility from Development Engineering to Manufacturing; and achieve process certification.

5.4.5.1 Phase 4A Exit Criteria

Product assumptions evaluated since Phase 3 Exit. Manufacturing plans updated and significant changes communicated to the Product Team.

Quality of the product in the worldwide manufacturing process certified by the Group Quality Manager.

Manufacturing achieved steady–state volume ramp.

Manufacturing Plan Executive Summary available for the Phase 4A Business Plan.

Copies of approved Phase 4A Manufacturing exit plans submitted to the Product Manager.

5.4.5.2 Phase 4A Activities

Demonstrate worldwide capability to achieve operational goals and objectives during ramp–up.

Complete Process Qualification Testing (PQT) and resolve all open issues.

Commence On–going Reliability Testing (ORT), ensure that manufacturing induced reliability problems are quantified, and establish corrective action.

Ensure that a customer feedback loop providing product performance information is in place (according to the Customer Audit Plan), and that manufacturing–induced problems are identified and resolved.

Update Manufacturing control systems based on process feedback.

Publish Process Enhancement and Cost Reduction Plan.

Ensure that all quality contracts are signed, as applicable.

Audit and certify product and volume processes.

Reassign New Product Start–Up Team.

Supply Field Service Logistics (FSL) with spares according to plan.

5.4.6 Phase 4B – Steady–State Operation

Objectives: Maintain steady–state volume production to meet customer demand, improve quality, and reduce manufacturing cost.

5.4.6.1 Phase 4B Exit Criteria

Product assumptions evaluated since the Phase 4A Exit. Manufacturing Plans updated and significant changes communicated to the Product Team.

Manufacturing Product Phase Down (PPD) Plan written, reviewed, approved, and published.

Establish Product Phase Down (PPD) Build quantity.

Copies of approved Phase 4B Manufacturing exit plans submitted to the Product Manager.

5.4.6.2 Phase 4B Activities

Manage processes using statistical process control methods.

Meet worldwide customer demand.

Ensure continuous, ongoing process enhancement including internal and external cost reductions, quality, and productivity improvements.

Manage manufacturing process to implement ECOs and mid–life product enhancements, if applicable.

Continue to manage customer feedback (hardware/software processes).

Continue to evaluate data from Ongoing Reliability Testing (ORT).

Determine method of phase down:

- Shut down all processes and manage inventory exposure.
- Build to inventory and stock to support market forecast.
- Implement controlled process reduction until customer demand ceases and inventory is exhausted.

Define inventory expense and impact per business analysis:

- Define inventory expense and investment exposure.
- Coordinate Order Administration activity.
- Finalize Order Administration Plan.
- Develop critical demand process.

Redefine material acquisition requirements and schedule.

Define vendor management strategy.

Product Phase Down Plan written, reviewed, approved, and published.

Report trademark misuses and infringements by customers and competitors to Trademark Services Law Group.

Review all functional PPD Plans including Product Management, Engineering, Manufacturing, Marketing, Customer Services, and Sales.

5.4.7 Phase 5 – Product Retirement (Service Continues)

Objective: Phase down the product.

Phase down can be accomplished using various techniques, including:

- Stopping production and managing inventory.
- Building to inventory and storing finished goods.
- Reducing manufacturing to low levels until customer demand is exhausted.

Selection of the appropriate technique is based on many factors, including product positioning, customer needs, inventory, volume plant load, and vendor stability.

Manufacturing is relieved of responsibilities when worldwide production ceases and Manufacturing transfers process and build responsibility to Customer Services. There may be instances when Manufacturing continues to build product to support Customer Services throughout the service life of the product; such a strategy must be determined in concert with Customer Services.

5.4.7.1 Phase 5 Closure Activities

Pending final decision of the Product Phase Down Team, reassign, dispose of, or hold inventory and capital equipment (according to agreed upon schedule of disposition).

Execute Phase 4B Product Phase Down plans and revisions.

Integrate Manufacturing plants (worldwide) to phase down product per plans.

Cease worldwide production of the product.

Transfer product control to Customer Services, if planned.

Archive all manufacturing documentation, both product and process.

Provide final impact statement (personnel, materials, equipment, environment, financials, and inventory).

Manage customer satisfaction perspectives. Minimize risks and trade–off exposure.

Arrange vendor phase down.

Manage final build process and PPD distribution.

Disposition excess inventory and capital equipment.

Reassign Manufacturing Phase Down Team.

Close out all product–specific financial control accounts/numbers.

5.5 REQUIRED MANUFACTURING DOCUMENTS

The overviews and outlines contained in this section serves as guidelines for creation of the plans and documents used by the Manufacturing Manager. The outlines present the minimum requirements for manufacturing plans and documents submitted for Phase Exit approval. The content, style, and scope of the plans and documents described herein may vary for hardware and software products, and across Manufacturing groups.

This section describes the following Manufacturing documents:

- Manufacturing Impact and Requirements Document
- Manufacturing Plan

NOTE

Online versions of the outline are available as a VAX DOCUMENT .SDML file and an ASCII file from Standards and Methods Control. Use the following file specification to obtain templates for the Manufacturing Plan.

JOKUR::PHASE_REVIEW:MFG_PLANS.SDML
JOKUR::PHASE_REVIEW:MFG_PLANS.TXT

Contact JOKUR::SMC regarding problems copying these files.

5.5.1 Manufacturing Impact and Requirements Document

OVERVIEW

Purpose:

Define and record the product's impact on: manufacturing technology, other products, and processes, manpower, space, cost, and required support.

Desired Characteristics:

Manufacturing long–range planning dependency assessment, key program mile–stones, build concepts, and manufacturability issues relating to design.

Audience:

All functional groups supporting the product.

Who is Responsible:

Manufacturing System Program Manager (MSPM) or Manufacturing member of the Product Team.

When Required:

Phase 0.

Relationship to Other Plans:

Summary included in the Product Business Plan.

MANUFACTURING IMPACTS AND REQUIREMENTS DOCUMENT OUTLINE

NOTE

The same outline is used for the Manufacturing Impact and Requirements Document and the Manufacturing Plan.

1.0 EXECUTIVE OVERVIEW

Volume source, program cost, schedule, major impacts, risks, opportunities, and major goals and objectives.

Purpose: Why are we doing this? What do we hope to accomplish?

- Major priorities (Time to Manufacture (TTM), cost, others)
- Major assumptions
- Major deviations from norm
- Major dependencies
- Make/buy alternatives considered (reason for acceptance or rejection)
- Brief product description
- Used on what products, if applicable
- Impact on other Digital products
- Marketing need and strategy—brief overview

2.0 MANUFACTURING BUSINESS STRATEGY

Where, how, and why product fits. Major worldwide manufacturing impact. Major goals and objectives.

3.0 PROCESS CAPABILITY STRATEGY

Major process changes. Process strategy. Assembly, test, and diagnostic coverage. Major goals and objectives. State–of–the–art process level. Impact on in–plant systems. Space impact. Capital impact. Competitive analysis of process.

MANUFACTURING IMPACTS AND REQUIREMENTS DOCUMENT OUTLINE (continued)

4.0 MAJOR MILESTONES AND SCHEDULE

5.0 MAJOR RISKS AND OPPORTUNITIES

Prioritize and indicate risk management.

6.0 MAJOR DEPENDENCIES

7.0 ORGANIZATIONAL IMPACTS

Strategy, teams, training, organizational design, and skills assessment.

8.0 FINANCIALS

New Product Start–Up (NPSU), capital expenditures, Return on Investment (ROI), Return on Assets (ROA), and transfer cost.

9.0 QUALITY STRATEGY AND PLANS

Qualification strategy and plans. Quality and reliability goals and objectives. Plans to get there. Data requirements and impacts. Data collection systems. In–process controls. POM strategy and plans. Revision control method.

10.0 MATERIALS STRATEGY AND PLANS

Sourcing strategy, plans, and flow. Inventory strategy, goals, and plans. Input/Output (I/O). Distribution strategy and plans. Header and order administration contacts.

11.0 PURCHASING STRATEGY AND PLANS

Key components and vendors identified. Sourcing strategies. Plans for getting vendors on QVL. Plans for obtaining materials for build plans. Documentation control method.

12.0 SOFTWARE STRATEGY AND PLANS

13.0 DOCUMENTATION STRATEGY AND PLANS

14.0 PHASE 2 AND 3 BUILD PLAN

Quantity required. Where built? Process plans. Human resources and training plans. Who will pay? Repair and scrap responsibilities.

15.0 SHIP AND BUILD PLANS

16.0 ATTACHMENTS

Business Plan and other applicable documents.

5.5.2 Manufacturing Plan

OVERVIEW

Purpose:

The Manufacturing Impacts and Requirements Document provides details of how, where, and when the product will be supplied. Considerations of the plan include:

- Customer Satisfaction through timely delivery of reliable products.
- Volume replication of qualified hardware and software.
- Cost reduction through product and process improvement.

Desired Characteristics:

- Manufacturing milestones schedule commitments
- Product volume supply commitments
- Detailed product plans from:
    - Materials
    - Quality
    - Manufacturing Engineering
    - Finance (Manufacturing Budgets)
    - Production
    - Information Systems
    - Organizational Development

MANUFACTURING PLAN OVERVIEW (continued)

Audience:

All functional groups supporting the product.

Who is Responsible:

Manufacturing Systems Program Manager (MSPM) or Manufacturing member of the Product Team.

When Required:

Prepared during Phase 1 and updated in each Phase.

Relationship to Other Plans:

A summary of the Manufacturing Plan is included in the Product Business Plan.

MANUFACTURING PLAN OUTLINE

NOTE

Use the format of the Impact and Requirements Statement for the Manufacturing Plan. Certain sections may be left blank due to unavailability of information during Phase 0. List major changes since last the plan and indicate section and page references for more detail.

Chapter 6

CORPORATE PRODUCT OPERATIONS – SALES

6.1 PURPOSE

As each high revenue impact product moves through its life cycle, Corporate Product Operations uses the Phase Review Process to solicit worldwide inputs for the product and to establish criteria for a successful, well–integrated product introduction; mid–life enhancements; and product phase down.

NOTE

During the Phase Review Process, Corporate Product Operations represents Sales for all Geographies. Digital organizes its business according to the following Geographies: U.S., Europe, and the General International Area (GIA).

6.2 FUNCTIONAL RESPONSIBILITIES

6.2.1 Corporate Product Operations

Corporate Product Operations' responsibilities include:

- Managing major product introductions worldwide, as well as coordinating post–announcement programs through the Announcement Strategy Committee (ASC) and related functional groups, such as the Field Launch Committee (FLC); the Press, Consultants, and Analysts (PCA); and the Marketing Advisory Board (MAB).
- Supporting the Marketing and Sales Strategy Committee (MSSC) on strategic pricing, and coordinating the development of short–term merchandising programs.
- Managing the worldwide Product Captain's process; coordinating product plans between Engineering, Manufacturing, Marketing, Sales and Services; and driving both the Corporate 3–Year and 8–Quarter Volume planning processes on behalf of Sales.

6.2.2 Product Captain

Sales' perspectives of the product are represented to the PBU or other sponsoring organizations by the Product Captain, who approves phase exits as the Sales representative to the Product Team. It is crucial that the Product Manager involve the Product Captain as early as possible in the Phase Review Process, because their understanding and support of the product greatly enhances the role of the ASC and FLC at product introduction.

6.2.3 Geographies

Geographies' responsibilities through the Product Captain process include:

- Working with the Product Team to validate business assumptions of the product in terms of volume, price and market size, and to position the product with respect to internal products and external competition.
- Providing requirements and feedback that increase the productivity of the sales force, such as training, Sales and Customer tools, and Introduction and Program plans.
- Providing required information to the Product Captain for the Sales Impact and Requirements Document to communicate sales requirements that the Geographies see as necessary for the Phase 0 plan.
- Developing a Sales Plan that includes a sales strategy showing how and where the product will be sold, documenting programs (initial and continuing training, introduction activities), channels of distribution, initial volumes, and suggested positioning and impact on current products.
- Supporting development of product introduction strategies and coordinating execution of these strategies.
- Providing continuous feedback regarding sales of the product and its performance in the field to other organizational functions.

6.2.4 Corporate Introduction Process

One of the key phases in the product life cycle is Product Introduction. During the introduction process, the Product Manager may interface with ASC, MAB, FLC, PCA, and the Pricing and Announcement Committee (PAC).

The introduction phase in the life cycle of a strategic product is complex and crucial to the overall success of the product. For this reason, emphasis is placed on the implementation of the product introduction and the resources required to facilitate this implementation.

EL–CP595–00, The Corporate Product Introduction Guide describes in detail the entire announcement process, the available resources, and the steps required to successfully implement a corporate announcement. It is crucial that the Product Manager thoroughly understand the Corporate Introduction Process.

6.3 SALES ACTIVITIES AND DELIVERABLES

The Product Captain prepares Sales input documents for products deemed to have a significant revenue, "style of doing business," or leverage characteristics. These products are generally High Impact Hardware (H1) and High Impact Software (S1) category products. For some component products, such as large disks or terminals, an entire planned family of products is documented.

As the product moves through its various phase exits (shown in Figure 6–1), the respective Product Captain provides written inputs to the Product Manager through the Sales Impact and Requirements Document and the Sales Plan.

Figure 6–1: Product Captain Deliverables

	PHASE						
	0	1	2	3	4A	4B	5
DELIVERABLES	Impact and Requirements Document	Sales Plan				Sales Phase Down Plan Written	Executed
FORMAT	Pre-Product Announcement Format			Post-Product Announcement Format			

Fig6_1

The objectives of the Sales documents used for input to the Business Plan are "issues" oriented. The key objective is to address important issues through a management summary, directed at Sales Management and the Product Team.

Typical areas of consideration are covered in the Sales Memory Joggers, which are listed under heading 6.4, Executing and Exiting Each Phase.

For Top 100 Products, the Product Manager in the respective PBU or other sponsoring organization provides product status to the Product Captain throughout the product's life cycle. The Product Captain, representing Sales, determines the revenue and/or market impact of the product and then determines if a Sales Impact and Requirements Document or Sales Plan is required.

Note that the Product Manager may not receive an Impact Statement or Plan for each Top 100 product: At a minimum, the Product Manager shall receive from the Product Captain an acknowledgment of involvement or recommended alternative direction on how to acquire Sales input during each Phase of the product's life cycle.

If Sales determines that the product's sales impact is high, and that the product warrants an Impact and Requirements Document or a Sales Plan, the Product Captain shall initiate the document.

The Product Captain's input to the sponsoring organization is an integration of the following worldwide functional Sales groups' inputs:

- Sales and Area Programs
- Sales Training
- Corporate Accounts
- Sales Support
- Corporate Product Introduction/Promotion
- Sales Operations

Each phase in the product's life cycle provides a mechanism for systematic review of proposals, plans, and results in a manner that allows for controlled funding, resource allocation, and project approval. Sales is responsible for the Phase Review activities shown in Figure 6–2.

Figure 6–2: Sales Activities

PHASE					
0	1	2	3	4A 4B	5
Impact and Requirement Document	Sales Plan	Sales Plan Introduction Strategy Introduction Plan (2) Develop Sales Material(2) ASC Reviews	Sales Plan Product Introduction Post Introduction Review (2)	Sales Plan Phase Down Decision Made In Phase 4B	Sales Plan Phase Down
	Proprietary Information Disclosure (1)	Proprietary Information Disclosure (1)	Proprietary Information Disclosure (1)		

(1) Corporate Product Operations will look to the Product Manager for the Proprietary Information Disclosure (PID), and will assist in its implementation. See DEC STD 197-0.

(2) Refer to "Corporate Product Introduction Guide" for definitions and further information on these activities.

Fig6_5

6.4 EXECUTING AND EXITING EACH PHASE

For each phase in the product's life cycle, there is a list of Exit Criteria, supporting Activities, and a set of questions that serve as Memory Joggers for the Product Captain. These questions are not all–encompassing; their purpose is to stimulate the thought process and surface issues as early as possible in the phase.

6.4.1 Phase 0 – Strategy and Requirement

Objectives: Communicate to the sponsoring organization the product requirements that Sales sees as necessary to take advantage of market and/or revenue opportunities, enhance product positioning, or lower the cost of doing business.

Obtain support for the product from appropriate Sales–related functional groups.

6.4.1.1 Phase 0 Exit Criteria

Sales supports the Business Plan.

Sales Impact and Requirements Document completed, if applicable.

Copies of approved Phase 0 Sales exit plans submitted to the Product Manager.

6.4.1.2 Phase 0 Activities

Review of the business assumptions by the three Geographies (U.S., Europe, and GIA.

Memory joggers reviewed and issues appropriately addressed.

Sales Impact Requirements Document issues mutually and satisfactorily resolved by Sales and other members of the Product Team.

6.4.1.3 Phase 0 Memory Joggers

Revenue Impact

What price band does the product fill?

Into what market(s) will the product be sold?

What is the business problem we are solving with the product?

How will the product impact other Digital products?

Will the product help make other products more useful?

Are related hardware or software products required, such as graphics printers, larger disks, and applications?

Are product feeds and speeds sufficient or are there architectural issues? For example: Is the I/O capability matched to the CPU power for the applications expected to be sold?

Are overlap products planned for Digital products or possible competition?

Sales Readiness

Are other Sales related cross–functional groups aware of this product and are they incorporating it into their plans?

Sales Strategies

Can the product be used with existing applications?

Should early technology announcements be made?

How does the product fit into Digital's Sales strategy?

What industry and applications marketing plans will be required?

Who are the major competitors in each price band and what is their market share?

From whom do we expect to take market share and why?

6.4.2 Phase 1 – Planning and Preliminary Design

Objectives: Ensure implementation of Sales Phase 0 product inputs to the Product Team. Communicate assumption changes to the Geographies.

6.4.2.1 Phase 1 Exit Criteria

Sales' Phase and Exit requirements incorporated into the product, and differences resolved by the Product Team.

Product assumptions and requirements evaluated since the Phase 0 exit. Sales plans updated and significant changes communicated to the Product Team.

Marketing Plan received and reviewed by Sales.

Sales strategy formulated and implemented.

Sales nominates or is in agreement with the nominated selection of Field Test Sites.

Executive Summary of the Sales Plan submitted by the Product Captain for inclusion in the Phase 1 Business Plan.

Copies of approved Phase 1 Sales exit plans submitted to the Product Manager.

6.4.2.2 Phase 1 Activities

Consult with the Law Department to ensure that pre–announcement activities, through the the Product Information Disclosures (PIDs), allow for timely implementation of the protection strategy.

Ensure that the PID has been written and approved, if appropriate.

Annotate the Sales Impact and Requirements Document with the latest Product Team commitments.

Write the Sales Plan.

6.4.2.3 Phase 1 Memory Joggers

Revenue Impact

What are the projected technical, operational, sales, and service related risks for the project?

Is there an impact on other Digital products targeted for introduction in the same time frame? If so, to what extent?

What price band does the product fill?

Into what market(s) will the product be sold?

What business problem does the product solve?

How will the product impact other products sold by Digital?

Will the product help make other products more useful?

Are related hardware or software products needed, such as graphics printers, larger disks, and applications?

Are product feeds and speeds sufficient or are there architectural issues? For example: Is the I/O capability matched to the CPU power for the applications expected to be sold?

Are overlap products planned for Digital Products or possible competition?

Sales Readiness

Are other worldwide Sales and related cross-functional groups incorporating this product into their plans, including Marketing, Sales Support Training, and Field Service.

Sales Strategies

Does the product require new applications, wiring, or environmental changes?

How will the Sales force be motivated to sell the product?

Will there be long sales cycles?

Is the product priced properly for the intended channel?

Is the packaging scheme overly complex?

Can the product be used with existing applications?

Are related hardware, software, and service products required?

When should we start integrating the product into Digital's customer plans?

Should early technology announcements be made?

Has the PID presentation and implementation plan been developed and approved by the responsible management and Corporate Product Operations?

What will be the product's distribution channels?

Are there any issues relative to competitors' strengths or sales methods?

How does the product fit into Digital's Sales strategy?

How can we test our sales strategy for the product?

What industry and applications marketing plans will be required?

Who are the major competitors in each price band and what is their market share?

From whom do we expect to take market share and why?

6.4.3 Phase 2 – Design and Implementation

Objective: Establish criteria for a successful, well-integrated product introduction.

6.4.3.1 Phase 2 Exit Criteria

Sale's Phase 1 Exit requirements incorporated into the product, and differences resolved by the Product Team.

Product assumptions and requirements evaluated since the Phase 1 exit. Sales plans updated and significant changes communicated to the Product Team.

Sales agrees on product quality, manufacturing volumes, market readiness, product positioning, and the overall plan.

Sales Plan updated and distributed to Product Management and other related sales functional groups.

6.4.3.2 Phase 2 Activities

Review the product to ensure that committed Sales requirements have been implemented.

Product Captain updates the Sales Plan.

Approve the list of nominated Field Test Sites.

Consult with the Law Department to ensure that new pre-announcement activities through Product Information Disclosures (PIDs), allow for timely implementation of the protection strategy.

Develop an implementation plan for the Proprietary Information Disclosure (PID).

Product Captain develops the Introduction Strategy and presents it to the appropriate committee.

Corporate Product Operations integrates the Corporate Introduction Plan.

Receive product introduction information package from Product Management and distribute package to the Geographies to determine Sales equipment requirements for Introduction activities.

6.4.3.3 Phase 2 Memory Joggers

Revenue Impact

What are the projected technical, operational, sales, and service related risks for the project?

Is there an impact on other Digital products targeted for introduction in the same time frame? If so, to what extent?

Is there a PBU, Sales, and Marketing agreement on the 8–Quarter Volume Plan?

What are the key risks regarding the product's availability, including legal, engineering, manufacturing, software, and service risks?

Has PAC approved the product's pricing?

What price band does the product fill?

What is the business problem we are solving with the product?

How will the product impact other products sold by Digital?

If this is a replacement product, are there backlog issues?

Will the product help make other products more useful?

Are overlap products planned for Digital products or possible competitor's products?

Sales Readiness

Has the Product Introduction Information Package been distributed to the Geographies, and have they responded with their introduction equipment forecasts and plans to Corporate Product Operations?

At announcement, will all introduced products be available for FRS? If not, will announcement waivers be required?

Can Field Test Sites also be used for public testimonials of the product?

What testing has the product received or will it receive to ensure high availability (uptime)?

What benchmarks and application characterizations will Sales receive to compare the product to other Digital and non–Digital products?

What application demos will be available to Sales so that they can properly demonstrate the overall solution?

Can Manufacturing support the Field Ship Plan for the first 90 days after FRS?

What out–of–the norm resources are required to sell this product?

Does a 1–year or 5–year cost–of–ownership competitive comparison exist? Has Corporate Product Operations reviewed the comparison?

Into what market(s) will the product be sold? Is the Sales Force equipped to sell the product into this market?

Is the Product Manager aware of the process for successfully positioning and introducing Corporate products in the marketplace?

Has the Product Manager read the *EL–CP595–00, Corporate Product Introduction Guide* from Corporate Product Operations?

Is the product complete in terms of customer requirements?

Is product interconnectability an issue?

Are product feeds and speeds sufficient or are there architectural issues? For example: Is the I/O capability matched to the CPU power for the applications expected to be sold?

What sales and sales support training will be required?

What are the customer training requirements?

Sales Strategies

What are the customer migration issues?

Is there a plan to handle customer migration issues?

Are related hardware or software products required, such as graphics printers, larger disks, and applications?

Does the product require new applications, wiring, or environmental changes?

How will the sales force be motivated to sell the product?

Will there be long sales cycles?

Is the product priced properly for the intended channel?

Will special terms and conditions be required?

Is the packaging scheme overly complex?

Can the product be used with existing applications?

Are related hardware, software, and service products required?

When should we start integrating the product into Digital's customer plans?

Has the PID Presentation and Implementation Plan been developed and approved by the responsible management and Corporate Product Operations?

Should early technology announcements be made?

What will be the product's distribution channels?

Will we need special product merchandising?

Are there any issues relative to competitors' strengths or sales methods?

How can we test our sales strategy for the product?

How does the product fit into the Digital Sales strategy?

What industry and applications marketing plans will be required?

What are the major themes and messages associated with the product?

What is the announcement strategy?

Who are the major competitors in each price band and what is their market share?

From whom do we expect to take market share and what is the plan to accomplish this?

6.4.4 Phase 3 – Qualification

Objectives: Implement the Corporate Introduction Plan to ensure that Sales can successfully market, sell, and support the product.

Successfully announce the product so that it meets the introduction goals and objectives established by Announcement Strategy Committee (ASC).

6.4.4.1 Phase 3 Exit Criteria

Product assumptions and requirements evaluated since the Phase 2 exit. Sales plans updated and significant changes communicated to the Product Team.

Sales is satisfied that the overall system solution meets customer requirements as defined in the Phase 2 Sales Plan. These requirements include hardware, system software, Digital layered products, 3rd party hardware and software, system integration, services, and overall quality.

First Revenue Ship (FRS) accomplished.

All Announcement and FRS criteria met and adequate product volumes available to meet sales' demand.

Sales Plan updated.

Copies of approved Phase 3 Sales exit plans submitted to the Product Manager.

6.4.4.2 Phase 3 Activities

Ensure that all introduction checklists for product readiness and introduction readiness are completed and have been reviewed by the appropriate committees.

Ensure that the overall system solution is evaluated and meets customer requirement.

Update and implement the Introduction Plan.

Drive the development of quality sales materials, sales tools, sales training, and introduction programs.

Develop and implement the First Day Order Process.

6.4.4.3 Phase 3 Memory Joggers

Revenue Impact

What are the projected technical, operational, sales, and service related risks for the project?

Is there an impact on other Digital products targeted for introduction in the same time frame? If so, to what extent?

Does a 1–year or 5–year cost–of–ownership competitive comparison exist? Has Corporate Product Operations reviewed the comparison?

Is there a PBU, Sales, and Marketing agreement on the 8–Quarter Volume Plan?

What are the key risks regarding the product's availability including legal, engineering, manufacturing, software, and service risk?

Has PAC approved the product's pricing?

Will the product impact other products sold by Digital?

If this is a replacement product, are there any backlog issues?

Sales Readiness

Has the Product Introduction Information Package been distributed to the Geographies, and have they responded with their introduction equipment forecasts and plans to Corporate Product Operations?

At announcement will all introduced products be available for FRS? If not, will announcement waivers be required?

Can Field Test Sites also be used for public testimonials of the product?

What testing has the product received or will it receive to ensure high availability (uptime)?

What benchmarks and application characterizations will Sales receive to compare the product to other Digital and non–Digital products?

What application demos will be available to Sales so that they can properly demonstrate the overall solution?

Can Manufacturing support the Field Ship Plan for the first 90 days after FRS?

What (out–of–the–norm) resources are required to sell this product?

Is the Product Manager aware of the process for successfully positioning and introducing Corporate products in the marketplace?

Has the Product Manager read the *EL–CP595–00, Corporate Product Introduction Guide* from Corporate Product Operations?

Is the product complete in terms of customer requirements?

Is product interconnectability an issue?

What skills and tools will the sales force need to sell the product as a customer solution?

What sales and sales support training will be required?

What are customer training requirements?

Sales Strategies

What are the customer migration issues?

Is there a plan to handle customer migration issues?

Does the product require new applications, wiring, or environmental changes?

How will the sales force be motivated to sell the product?

Will there be long sales cycles?

Will special terms and conditions be required?

Is the product packaging scheme overly complex?

Are related hardware, software, and service products required?

When should we start integrating the product into Digital's customer plans?

Has the PID presentation and implementation plan been developed and approved by the responsible management and Corporate Product Operations?

Will we need any special product merchandising programs?

Are there any issues relative to competitors' strengths or sales methods?

How can we test our sales strategy for the product?

What industry and applications marketing plans will be required?

What are the major themes and messages associated with the product?

What is the announcement strategy?

Who are the major competitors in each price band and what is their market share?

From whom do we expect to take market share and what is the plan to accomplish this?

6.4.5 Phase 4A – Ramp–Up

Objective: Ensure that revenue and volume Sales Plans are meeting expectations.

6.4.5.1 Phase 4A Exit Criteria

Product assumptions evaluated since the Phase 3 exit. Sales plans updated and significant changes communicated to the Product Team.

Sales agrees that the volume ramp and product quality are adequate to meet demand.

Copies of approved Phase 4A Sales exit plans submitted to the Product Manager.

6.4.5.2 Phase 4A Activities

Conduct a Post–Introduction Review to ensure that adequate sales and marketing programs are in place to support manufacturing volume.

When product demand/supply imbalance exists, implement special sales programs.

Prepare to implement post–introduction sales strategies, such as mid–life kickers.

Work with the Product Team to convey Digital's messages to customers.

Update the Sales Plan.

6.4.5.3 Phase 4A Memory Joggers

Revenue Impact

How is the product being received by Digital's customer?

Are there technical, operational, sales, and service related issues?

Can manufacturing continue to support the Field Ship Plan?

Is there a PBU, Sales, and Marketing agreement on the 8-Quarter Volume Plan?

When is it appropriate to phase down the product?

Sales Strategies

Have product introduction goals been meet?

What additional programs are needed to ensure that business goals are met? Who will drive these programs?

6.4.6 Phase 4B – Steady-State Operation

Objectives: Review Sales objectives, strategies, tactics, and programs for the product, and propose replacement and enhancement strategies. Prepare Sales for product phase down plan.

6.4.6.1 Phase 4B Exit Criteria

Provide the Product Manager with Sales input to the Product Phase Down (PPD) Plan.

6.4.6.2 Phase 4B Activities

Review all functional Product Phase Down (PPD) Plans including Product Management, Engineering, Manufacturing, Marketing, Services, and Sales.

Work with cross-functional sales groups to maximize product revenue.

Participate with the other members of the Product Team to develop replacement and Product Phase Down messages for customers.

Write the Sales PPD Plan.

6.4.6.3 Phase 4B Memory Joggers

Has the Product Captain notified the three Geographies of the Product Phase Down strategy?

Revenue Impact

When is it appropriate to phase down the product?

Sales Strategies

What is the plan to communicate the Phase Down Strategy to customers and sales?

6.4.7 Phase 5 – Product Retirement (Service Continues)

Objectives: Maintain customer satisfaction, refrain from selling the product, and ensure that a proper alternate product replacement strategy is in place.

6.4.7.1 Phase 5 Activities

Ensure that there are NO customer satisfaction issues relative to the phase down strategy, such as contractual obligations and migration plans.

Product Captain ensures that the Product Manager has completed the necessary paperwork to remove the product from the "Active" section of the price book.

Participate with other members of the Product Team to deliver the replacement and Product Phase Down messages for customers.

6.5 REQUIRED SALES DOCUMENTS

The overviews and outlines contained in this section serve as guidelines for the creation of the plans and documents used by the Product Captain (or Product Manager, as warranted by the product) in support of the Phase Review Process. The outlines present the minimum requirements for Sales plans and documents submitted for Phase Exit approval. The content, style, and scope of the plans may vary for hardware and software products.

The following pages show samples of the formats for the following documents:

Sales Impact and Requirements Document for Phase 0 Exit (Pre-Product Announcement Outline)

Sales Plan for Phase 1, 2, and 3 Exits (Pre-Product Announcement Outline)

Sales Plan for Phase 4A and 4B Exits (Post-Product Announcement Format)

NOTE

Online versions of these outlines are available as a VAX DOCUMENT .SDML file and an ASCII file from Standards and Methods Control. Use the following file specifications to obtain outlines for the required Sales Plans.

JOKUR::PHASE_REVIEW:SALES_PLANS.SDML
JOKUR::PHASE_REVIEW:SALES_PLANS.TXT

Contact JOKUR::SMC regarding problems copying these files.

OVERVIEW OF SALES DOCUMENTS

NOTE

The overview presented here is used for all three sales documents.

Purpose:

The Product Captain's deliverables, through the Impact and Requirements Document and the Sales Plan are to:

- Provide evaluation of the product from the Sales' perspective.
- Provide a method to approve each Phase Exit for Sales.
- Escalate unresolved Phase Exit issues to senior management.
- Provide updated information as Sales programs are initiated and modified.

Who is Responsible:

The Product Captain, as defined under subheading 6.2 Functional Responsibilities. When Sales has determined that it need not be directly involved as a member of the Product Team, the Product Manager coordinates with the Marketing Member of the Product Team to complete all announcement and Sales related activities and exit criteria.

OVERVIEW OF SALES DOCUMENTS (continued)

When Required:

When Sales deems it appropriate, each phase exit requires a Sales Impact and Requirements Document or a Sales Plan.

Audience:

The Sales Impact and Requirements Document and Sales Plan are written for Sales and the Product Team.

Relationship of Documents to Other Activities:

- Business Plan

  A summary of the Sales Impact and Requirements Document or the Sales Plan is included in the Product Business Plan.

- Marketing Plan

  The Sales Plan is developed and reviewed in conjunction with the Marketing Plan.

  Introduction Strategy and Corporate Introduction Plan

  The Sales Plan serves as a resource document for the Introduction Strategy and the Field portions of the Corporate Introduction Plan.

6.5.1 Sales Impact and Requirements Document for Phase 0 Exit (Pre–Product Announcement Outline)

The purpose of the Sales Impact and Requirements Document is to communicate to the sponsoring organization the product requirements that Sales sees as necessary to take advantage of market and/or revenue opportunities, enhance product positioning, or lower the cost of doing business. This document is also used to obtain the support of the appropriate Sales–related functional groups.

SALES IMPACT AND REQUIREMENTS DOCUMENT OUTLINE

1.0 INTRODUCTION

Statement of Purpose

Participating groups that provide inputs to the Impact and Requirements Document.

2.0 MANAGEMENT SUMMARY

A detailed Sales summary of key issues relative to the product. For example:
What functions and features are required in the product in order for it to be successful?
What sales strategy must be adopted?
What are some of the risks?

For additional questions, refer to the detailed memory joggers listed in this chapter.

3.0 PRODUCT ASSUMPTIONS

This section provides an understanding of the product, from a Sales perspective, and can be used to communicate information to other Sales–related Digital functional groups. It provides:

- Product Description
- Product Configurations
- ASVs (Average System Values)
- Announcement Date
- Manufacturing Ramp
- Performance Positioning
- Availability of Related Peripherals and Software
- Other pertinent information

6.5.2 Sales Plan for Phases 1, 2, and 3 Exits (Pre–Product Announcement Outline)

The purpose of the Sales Plan is to alert Sales functions; solicit support for products yet to be announced; and to establish criteria for a successful, well–integrated product introduction. In addition to Sales inputs from the Geographies, the Product Captain shall obtain Marketing inputs from the MAB Team's Marketing Plan.

The Sales Plan describes how and where a product will be sold, documenting programs (initial and continuing training, announcement day activities), channels of distribution, selling costs, initial volumes, and suggested positioning.

SALES PLAN OUTLINE FOR PHASES 1, 2, AND 3

* Refer to the Sales Impact and Requirements Document Outline for detail. (Subheading 6.5.1)

• 1.0 INTRODUCTION

• 2.0 MANAGEMENT SUMMARY

• 3.0 PRODUCT ASSUMPTIONS

4.0 ANNOUNCEMENT CHECKLIST

The checklist focuses and monitors issues that center on announcement readiness. The following committees consider them important for announcement:

MSSC – Marketing Sales and Strategy Committee
PAC – Pricing and Announcement Committee
ASC – Announcement Strategy Committee
FLC – Field Launch Committee
PCA – Press, Consultants, and Analysts
MAB – Marketing Advisory Board

SALES PLAN OUTLINE FOR PHASES 1, 2, AND 3 (continued)

There are four sections to the checklist. The content of each checklist is the responsibility of the following:

Checklist	Title	Responsibility
Checklist 1	Product Completion	Product Captain
Checklist 2	Customer Readiness	Business Management of Corporate Product Operations
Checklist 3	Press Day Readiness	PCA Committee
Checklist 4	Field Readiness	FLC

The Product Captain and the Product Manager begin the ASC checklist activities six months in advance of the scheduled product announcement date. See the *Corporate Product Introduction Guide* for samples of these checklists.

5.0 DETAILED SALES ACTION PLAN

This is a call–to–action driven by the Product Captain to ensure that the product achieves its introduction objectives. Develop this plan according to the following format:

Goal	Action Item	Performed By	Test For Completion	Date of Completion	Priority Low/Med/High

6.5.3 Sales Plan Outline for Phase 4A and 4B Exits (Post–Product Announcement Format)

The purpose of the Phase 4A and 4B Sales Plan is to integrate Corporate and Sales Field functions into a comprehensive set of action items to ensure that revenue and unit plans are met through product phase down. This format is used for products in the mature state of their life cycle.

SALES PLAN OUTLINE FOR PHASES 4A AND 4B

* Refer to the Sales Impact and Requirements Document Outline for detail (subheading 6.5.1).
** Refer to the outline of Sales Plan for Phases 1, 2, and 3 for detail (subheading 6.5.2).

* **1.0 INTRODUCTION**

* **2.0 MANAGEMENT SUMMARY**

* **3.0 PRODUCT ASSUMPTIONS**

4.0 PRODUCT ANALYSIS/PERFORMANCE

- Business Sizing
- Historical Sales Analysis
- Status Against Plan
- Deviation From Plan
- Supply Issues
- Forecast Issues

** **5.0 DETAILED SALES ACTION PLAN**

Chapter 7

CUSTOMER SERVICES

7.1 PURPOSE

Customer Services includes Field Service, Software Services, and Educational Services.

Customer Services provides an evaluation of the product impact on training needs for Educational Services, professional services for Software Services, and remedial and installation services for Field Service. They develop product service strategies and influence product goals through reliability and maintainability requirements, and availability features. These service strategies feed the service development process. Customer Services attempts to integrate service strategies with the Product Business Unit (PBU) or sponsoring organization strategy, in order to optimize Digital's ability to competitively meet customer needs.

Customer Services Systems Engineering (CSSE) is usually the Customer Services representative to the Corporate Phase Review Process. To meet the service delivery needs of Digital's customers, CSSE represents the needs of Field Service Educational Services and Field Service in the planning, development, and phase down of Digital's products. CSSE works closely with Educational Services and Software Services as their activities influence Field Service.

The Software Services (SWS) business now involves Professional Services, including custom applications, consulting, and residencies. SWS also have their own engineering function and, as such, develop corporate products. In addition, SWS performs a pre–sales function for the sales organization, develops service package for selected products, and maintains an Applications Software Solutions and Expertise Transfer Service (ASSETS) library to serve as foundations for customer solutions.

7.2 FUNCTIONAL RESPONSIBILITIES

Customer Services' responsibilities are to:

- Develop system, product, local– and wide–area networks, serviceability requirements, and plans that address service impact, requirements, and implementation.
- Develop service and support plans to ensure that products can be serviced by field support organizations.
- Ensure integration of service strategies with PBU or sponsoring organization strategies to optimize Digital's ability to meet customer needs.
- Ensure field preparedness to support the product throughout its life cycle by providing appropriate service tools such as diagnostics, documentation, training, and spare parts.
- Provide Corporate–level back–up and support to the Services' organizations.
- Manage service performance in the field throughout the product's life cycle.
- Monitor service metrics against goals and make, if necessary, appropriate recommendations to alter the product or product services.

7.3 CUSTOMER SERVICES ACTIVITIES AND DELIVERABLES

Figure 7–1 shows the deliverables and activities of Customer Services within the Phase Review Process.

Figure 7–1: Customer Services Activities and Deliverables

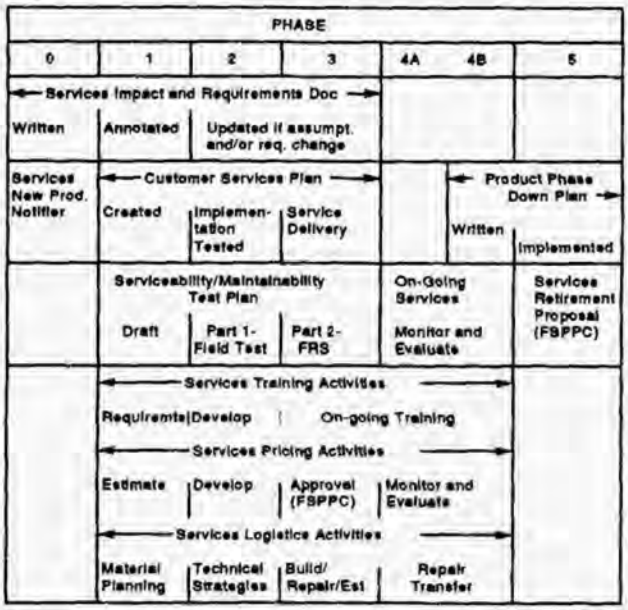


Fig7_1

7.4 EXECUTING AND EXITING EACH PHASE

Each phase in the product's life cycle provides a mechanism for the systematic review of proposals, plans, and results in a manner that allows for controlled funding, resource allocation, and project approval.

For each phase in this chapter, there is a list of Exit Criteria, supporting Activities and a set of questions that serve as memory joggers for the Customer Services Project Manager. These questions are not all–encompassing; their purpose is to stimulate the thought process and surface issues as early as possible in each phase.

7.4.1 Phase 0 – Strategy and Requirements

Objective: Develop a Services Impact and Requirements Document. This document includes the following:

- Product impact on services
- Business goals and impact
- Anticipated service strategy
- Serviceability requirements
- Reliability, Availability, and Maintainability Program (RAMP) and metrics

7.4.1.1 Phase 0 Exit Criteria

Services Impact and Requirements Document written, reviewed, approved, and published. Copies provided to the Product Manager for inclusion in the Product Requirements Document.

Services Impact and Requirements Document Executive Summary provided to the Product Manager for inclusion in the Phase 0 Business Plan.

Copies of approved Phase 0 Customer Services exit plans submitted to the Product Manager.

7.4.1.2 Phase 0 Activities

Write the Services Impact and Requirements Document.

Evaluate the Product and Market Requirements Documents to determine:

- How this product fits within the current service strategy
- What, if any, new pieces of the Service Strategy need to be created or modified

Become knowledgeable of future service strategies so as to understand the impact of this product on long–range service goals.

Create serviceability and RAMP goals for the product.

Work with the Product Team to understand the constraints and requirements of the proposed product.

Generate and distribute Services New Product Notifier to Customer Services.

7.4.1.3 Phase 0 Memory Joggers

What is the product's anticipated market life?

What is the product's anticipated service life?

Can the product be supported through existing service strategies?

Is the design compatible with existing test strategies used by Services?

If this design has been used in the past, what was its service cost breakdown?

What are the expected yearly build rates for the life of the product?

What effect will geographical markets have on support of the product?

Has the Customer Services Team been formed?

What are the Customer Services requirements for the total product? Include packaging, pricing, diagnostics, documentation, and testing.

7.4.2 Phase 1 – Planning and Preliminary Design

Objectives: Develop Customer Services Plan reflecting business goals and service strategies, serviceability goals for both product and service delivery, training intent, and estimated service pricing.

7.4.2.1 Phase 1 Exit Criteria

Services committed to supporting the product.

Assumptions and requirements evaluated since the Phase 0 exit. Functional plans updated and significant changes communicated to the Product Team.

Phase 1 Customer Services Plan written, reviewed, approved, and published.

Executive Summary of the Customer Services Plan included in the Phase 1 Business Plan.

Copies of approved Phase 1 Customer Services exit plans submitted to the Product Manager.

7.4.2.2 Phase 1 Activities

Analyze functional specifications, focusing on meeting hardware and/or software goals.

Analyze the product's quality goals to determine how well they support service goals, including Problem Free Installation (PFI), measured Mean Time Between Failures (MTBF), and revision management.

Annotate the Services Impact and Requirements Document with Engineering's commitments.

Work with Engineering to include agreed upon service requirements in the product.

Work with Engineering to include plans for testing the product with configurations representative of the intended user environment, complementary hardware and software products.

Prepare a draft of the Serviceability/Maintainability Test Plan.

Work with Educational Services to determine training requirements.

Supply the Product Manager with the estimated number of units required to support Phase 2 and 3 service activities.

Work with Software Product Services (SPS) and Hardware Product Services (HPS) to estimate service pricing, as required.

Assist Field Service Logistics (FSL) with their material planning needs.

Work with Field Service Geography Planning groups on their service delivery plans.

With Customer Services Team, agree on Services' Phase 1 Exit Criteria.

7.4.2.3 Phase 1 Memory Joggers

Have you evaluated design specifications and proposed specification changes to support the Services strategy?

How will product improvements or enhancements affect your support strategy?

Has the product been introduced on the New Product Planning Data Base (PASS)?

Has a replacement product been identified for this product?

Is there a strategy for product evolution or migration?

Is a corrective action system planned that directly links to the appropriate design support organization?

Has a time–phased schedule been prepared that outlines the key elements required for successful implementation of a product support plan?

Are self–test features incorporated into the product design?

What is your estimated Mean Time Between Failures (MTBF) and Mean Time to Install (MTTI) for product hardware?

For product software, what is your estimated Mean Time Between Call (MTBC), MTTI, and Software Problem Report (SPR)/QTR?

What is the update frequency and cost of media? (Software)

What is the anticipated contract penetration and mix?

What level of service is planned for OEMs, distributors, and end users?

Is a license agreement involved with the servicing of buyout products?

What percent of the product will require buyout spares? (Hardware)

Have you received and evaluated the Educational Service Strategies and Requirements Documents?

7.4.3 Phase 2 – Implementation and Design

Objectives: Deliver an updated Customer Services Plan.

Prior to Phase 2 exit, Customer Services delivers an updated Customer Services Plan including:

- Service Delivery Plan
- Service Operations Plan
- Training Plan
- Logistics Plan

7.4.3.1 Phase 2 Exit Criteria

Assumptions and requirements evaluated since the Phase 1 exit. Functional plans updated and significant changes communicated to the Product Team.

Customer Services Plan updated, including Service Delivery, Service Operations, Training, and Logistics (hardware) Plans.

Serviceability/Maintainability Test Plan written, reviewed, approved, and published.

Field Test support commitments completed. (Software)

Customer Services Plan Executive Summary included in the Phase 2 Business Plan.

Copies of approved Phase 2 Customer Services exit plans submitted to the Product Manager.

7.4.3.2 Phase 2 Activities

Review the design to ensure that committed Services requirements have been implemented.

Evaluate prototype against service requirements.

Evaluate qualification plans for service concerns.

Evaluate documentation drafts.

Execute Part 1 of the Serviceability/Maintainability Test Plan to ensure that the product is ready for Field Test.

Participate in Field Test Planning.

With Customer Services Team, agree on Services' Phase 2 Exit Criteria.

7.4.3.3 Phase 2 Memory Joggers

Has the Field Test strategy been provided for the product? Has a Field Test Plan been written?

Is a system in place to obtain feedback reports for field test sites?

Have you reviewed the final specifications?

Do special service tools need to be purchased or designed?

Is special product installation required?

Will storage and packing strategies meet your needs for site installation?

Has the Training Plan been updated?

Is a system in place to verify and certify the adequacy of training (both content and quantity of resources trained).

Is a process in place to update service manuals and associated documents?

Is any special site specification required?

Is any support subcontracted? Does the contract specify revision management control requirements?

Are you negotiating support contracts for all Geographies where the product will be sold?

For hardware products:

> Have prototypes and first production models been evaluated against service requirements?
>
> Does the self-test coverage provide useful diagnostic feedback for product repair?
>
> Has the Logistics Plan been updated?
>
> Have spares forecasts been placed on Manufacturing?
>
> How will the stock of spare parts be maintained in the plants? At the distributors? At repair centers?
>
> How many parts or components will be interchangeable?
>
> Is *DEC STD 009-0 Project Specification* information available from Engineering?
>
> Have contracts been signed for spares acquisition?
>
> Is Revision Management Documentation available from Engineering?

7.4.4 Phase 3 – Qualification

Objective: Prepare Customer Services for product service.

Prior to Phase 3 exit, Customer Services will deliver the final Customer Services Plan including:

- Service delivery commitment
- Training intent and/or Plan
- Logistics Plan
- Field readiness assessment
- Service pricing approval

7.4.4.1 Phase 3 Exit Criteria

Assumptions and requirements evaluated since the Phase 2 exit. Functional plans updated and significant changes communicated to the Product Team.

Service organizations prepared to service the product in all Geographies where the product will be sold.

Service pricing approved.

Customer Services Plan completed.

Problem reporting procedures operational and communicated to the field.

Maynard List Price (MLP), Software Product Description (SPD), and New Products Form (NPF) approved.

Serviceability/Maintainability Test Plan implemented.

Serviceability/Maintainability Test Evaluation written.

Customer Services Plan Executive Summary included in the Phase 3 Business Plan.

Copies of approved Phase 3 Customer Services exit plans submitted to the Product Manager.

7.4.4.2 Phase 3 Activities

With Customer Services Team, agree on Services' Field Readiness.

Participate in Field Test activity, as required.

Evaluate Field Test results for product readiness.

Report Serviceability/Maintainability Test results.

Monitor all Engineering Change Orders (ECOs) for Services impact, including assessing need for Field Change Orders (FCOs).

Evaluate Pricing and Announcement Committee (PAC) proposal for announcement and FRS readiness.

Ensure that release copies of diagnostics, documentation, and identified software are made available to appropriate Service personnel (such as support centers and districts) in time to support initial product shipments.

With Customer Service Team, generate Post-FRS reliability monitoring requirements.

7.4.4.3 Phase 3 Memory Joggers

Has the Customer Services Plan been updated?

Is documentation available to Service organizations that accurately depicts the product being shipped?

Have you reviewed the serviceability and maintainability of the product?

Has a Field Test Evaluation Report been written?

Are training and trained resources in place to support the product?

For hardware products:

- Has site management information for the product been communicated to the field?
- Has environmental information been provided to the field?
- Is interchangeability in the field assured?
- Are spare parts in place to support the product?
- Is a system in place to ensure that spare parts will be compatible with the hardware configuration for which they are to be used?
- Is a repair plan agreed upon?

Have Automatic Distribution System (ADS) kits been approved? (Software)

Have support starter kits been distributed to the field?

7.4.5 Phase 4A – Ramp–Up

Objective: Ramp up Service activities to meet steady–state service plans.

7.4.5.1 Phase 4A Exit Criteria

Assumptions and requirements evaluated since the Phase 3 exit. Functional plans updated and significant changes communicated to the Product Team.

Execute Customer Services Plan.

Achieved steady–state service capability worldwide.

Copies of approved Phase 4A Customer Services exit plans submitted to the Product Manager.

7.4.5.2 Phase 4A Activities

Ramp up training and material availability to meet the steady–state service plan.

Monitor all ECOs for services impact and assess need for FCOs.

Monitor service metrics against goals.

Monitor service penetration against plan

Monitor service delivery implementation against plan.

7.4.5.3 Phase 4A Memory Joggers

Has Support Engineering committed to support Services' problem reporting systems (such as Common Log Desk (CLD), Problem Resolution and Information Systems Management (PRISM), or Technical Information Management Exchange (TIME))?

7.4.6 Phase 4B – Steady–State Operation

Objective: Provide steady–state service levels, monitor Service activities against plans, and orchestrate change as necessary within Services.

7.4.6.1 Phase 4B Exit Criteria

Customer Services Product Phase Down Plan written, reviewed, approved, and published.

Customer Services Plan Executive Summary included in the Phase 4B Business Plan.

Copies of approved Phase 4B Customer Services exit plans submitted to the Product Manager.

7.4.6.2 Phase 4B Activities

Review all functional Product Phase Down (PPD) plans including those from Product Management, Engineering, Manufacturing, Marketing, and Sales.

Monitor all ECOs for services impact, and assess need for FCOs.

Review service pricing to maximize service revenue.

Review service offerings for new opportunities.

Look for ways to maximize results (to do better than planned).

Assess the Field Service Business impact, if any, of implementing excess inventory disposition programs. (Hardware)

Develop the long–range Installed Base Forecast.

Negotiate with Manufacturing on excess inventory disposal. (Hardware)

Monitor service metrics against goals.

Monitor service penetration against plan.

Monitor service delivery implementation against plan.

7.4.6.3 Phase 4B Memory Joggers

If applicable, has the PBU or sponsoring organization manager negotiated the transition of product management responsibilities?

Have you met with Training to review training strategy and implementation?

Have you notified Training and Documentation of changes in service strategy?

Has the most cost effective and long term logistics strategy been determined? (Hardware)

Are long term product material requirements sufficient?

Do contingency plans exist for ongoing manufacturing? (Hardware)

Have you investigated self–maintenance demands for modules, documentation, and diagnostics? (Hardware)

Have you determined a deinstallation strategy?

Have you evaluated the feasibility of CSSE providing engineering–level support?

If the product is software, have you considered transferring it to an alternative development group such as Mature Software Services?

If the product is software, have you deleted "H" kits and moved service items to maintenance only?

Has the Services Phase Down Template been entered into the Planning Automated Support System (PASS)?

7.4.7 Phase 5 – Product Retirement (Service Continues)

End of Sales Life and Ongoing Field Service Support

Objective: During Phase 5, Customer Services supports the Field Service Product Phase Down (PPD) Philosophy, which states:

"As business partners with our customers, and for as long as there is a customer need, we will continue to support Digital hardware and software products, or develop customer-specific solutions, when the Digital standard service offerings are no longer available."

7.4.7.1 Phase 5 Closure Criteria

All services cease.

7.4.7.2 Phase 5 Activities

Identify focused Product Team representatives responsible for developing account-specific End-of-Life (EOL) programs.

Look for ways to maximize results (to improve on past performance).

Provide ongoing customer support.

Ensure material availability for expected service life of the product.

Review results of the Customer Services Product Phase Down Plan to determine customer satisfaction.

If service is to be discontinued, sponsor a proposal to:

- Field Services Pricing and Procedures Committee (FSPPC)
- Field Services Policies and Procedures Review Committee (FSPPRC) (if reviewed by Field Service Management Committee (FSMC) for high impact or precedent setting proposals)

If the Corporate Product Phase Down Plan states that product responsibility transfers to Field Service, obtain approval from the other Field Service groups that Field Service is ready to accept designated responsibility.

7.4.7.3 Phase 5 Memory Joggers

Have you worked with Geographies to sponsor the FSPPC retirement proposal?

Have the geographical areas executed account–specific End–of–Life programs through the Product Team?

Have you investigated the centralization of field support resources?

Has a Sales Migration Plan been implemented?

Should standard service terms and commitments be revised?

Has self–maintenance support ended?

Has the software product been considered for transfer to the DECUS Public Domain Library? (binaries or sources)

7.5 REQUIRED CUSTOMER SERVICES DOCUMENTS

The overviews and outlines contained in this section serve as guidelines for creation of the plans and documents used by the Customer Services Manager in support of the Phase Review Process. The outlines present the minimum requirements for Customer Services plans and documents for Phase Exit approval.

The content, style, and scope of the plans and documents described herein may vary for hardware and software products, and across Customer Services Groups.

This section describes the following plans:

- Services Impact and Requirements Document
- Customer Services Plan
  - Software Customer Services Plan
  - Hardware Customer Services Product Plan
- Customer Services Phase Down Plan
  - Customer Services Hardware Product Phase Down Plan – High Impact Products
  - Customer Services Hardware Product Phase Down Plan – Low Impact Products
  - Customer Services Software Product Phase Down Plan – All Products

NOTE

Online versions of these outlines are available as a VAX DOCUMENT .SDML file and an ASCII file from Standards and Methods Control. Use the following file specification to obtain outlines of the required Customer Services Plans.

JOKUR::PHASE_REVIEW:SERVICES.SDML
JOKUR::PHASE_REVIEW:SERVICES.TXT

Contact JOKUR::SMC regarding problems copying these files.

7.5.1 Services Impact and Requirements Document (Phase 0)

OVERVIEW

Purpose:

- Assess the product impact on Customer Services' business goals.
- Provide timely, reliable technical information on product service needs to help make decisions on product development and set product goals.
- Increase customer satisfaction with Digital products and services.
- Improve the serviceability of Digital products.

Audience:

- Product Team Members
- Customer Services Team

Who is Responsible:

The designated Customer Services Manager.

SERVICES IMPACT AND REQUIREMENTS DOCUMENT OVERVIEW (continued)

When Required:

- The approved Services Impact and Requirements Document is required to exit Phase 0, and is annotated at the end of Phase 1 to reflect actual Engineering commitments.

Relationship To Other Plans:

- Service Plan

  The product requirements agreed to and incorporated in the Services Impact and Requirements Document are part of the Service Plan.

- Functional Specification

  Product requirements are input to the Functional Specification.

Where Recorded:

- Customer Services Systems Engineering (CSSE) New Product Planning

SERVICES IMPACT AND REQUIREMENTS DOCUMENT OUTLINE

1.0 EXECUTIVE SUMMARY

1.1 SUMMARY OF SERVICE IMPACT AND REQUIREMENTS
1.2 SUMMARY OF PRODUCT METRICS
1.3 SUMMARY OF RISKS AND CONCERNS

2.0 PRODUCT SUMMARY

3.0 IMPACT ON SERVICES

4.0 SERVICE STRATEGY

5.0 SERVICE BUSINESS GOALS

6.0 SERVICEABILITY REQUIREMENTS

6.1 INSTALLATION
6.2 REMEDIAL SUPPORT AND/OR REPAIR
6.3 TRAINING
6.4 MATERIAL REPAIR

SERVICES IMPACT AND REQUIREMENTS DOCUMENT OUTLINE (continued)

7.0 SERVICEABILITY GOALS

7.1 DOCUMENTATION

7.1.1 Product
7.1.2 Sources
7.1.3 Customer Communication
7.1.4 Service Communications

7.2 FUNCTION TESTS

7.2.1 Demonstration Programs
7.2.2 Installation Certification Procedure
7.2.3 Benchmarks

7.3 OTHER SPECIFICATIONS

8.0 RAMP AND METRIC REQUIREMENTS

8.1 INSTALLATION
8.2 CALLS

8.2.1 On–Site
8.2.2 Remote

Simple
Complex

8.3 WARRANTY
8.4 TRAINING

9.0 RISKS AND CONCERNS

7.5.2 CUSTOMER SERVICES PLAN (PHASES 1 THROUGH 3) HARDWARE or SOFTWARE

NOTE

Use the overview below with the hardware or software outline shown on succeeding pages, depending on the product.

OVERVIEW

Purpose:

The purpose of the Customer Services Plan (hardware or software) is to document the Customer Services delivery commitments. The plan is the outcome of the Customer Services Product Planning Process. This process is the communications vehicle used by the various Customer Services groups responsible for ensuring congruency between Customer Services delivery strategies and PBU product strategies.

Audience:

- Customer Services Geography Planning and support groups
- Manufacturing Planning
- Product Management
- Marketing
- Sales

CUSTOMER SERVICES PLAN (PHASES 1 THROUGH 3) HARDWARE OR SOFTWARE (continued)

Who is Responsible:

The Customer Services representative on the Product Team, with inputs from representatives from the organizations listed below, depending on product type:

- CSSE
- Educational Services
- Field Service Logistics
- Software Services
- Geography Planning Groups (U.S., Europe, GIA)

When Required:

The Service Plan is prepared at the beginning of Phase 1 and completed at close of Phase 3.

Relationship To Other Activities:

The Customer Services Plan is the Customer Services input to the Corporate Phase Review Process.

Where Recorded:

Customer Services Systems Engineering (CSSE) New Product Planning

SOFTWARE CUSTOMER SERVICES PLAN OUTLINE

1.0 EXECUTIVE SUMMARY

PLAN SUMMARY – Brief description of product, marketing, and service strategy .

BUSINESS IMPACT STATEMENT – Relationship to, and position in, the family business strategy.

KEY AND CRITICAL ITEMS – Key risks, concerns, option issues.

2.0 PRODUCT RECORD

Record of information containing key fields, such as:

- Product phase
- PAC category
- Service impact category
- Corporate backup group
- Field Test, Announcement, FRS dates

2.1 SERVICE DELIVERY PLANNING INFORMATION

Record containing information necessary to deliver services, such as:

- Product relationships to other products
- Hardware and/or software prerequisites
- Volume numbers
- Support tools available or planned
- Skill set required to provide support

2.2 BUSINESS CHECKLIST

Record containing information on service business planning, such as:

- Service revenue anticipated over two years
- Services planned
- Standard vs. non–standard services

SOFTWARE CUSTOMER SERVICES PLAN OUTLINE (continued)

2.3 PRODUCT SERVICE BUSINESS INFORMATION

Record containing information on intended services, such as:

- Impact on Software Product Services (SPS)
- Service offerings
- Customer base
- Problems per registered customers

2.4 GEOGRAPHY (U.S., EUROPE, GIA) SERVICE DELIVERY CALL FLOW MATRIX

Records containing information on how the three Geographies intend to support the product, including primary and secondary support for remedial and installation activity.

HARDWARE CUSTOMER SERVICES PRODUCT PLAN OUTLINE

1.0 DIAGRAM

Sections 1.0 through 2.0 are the responsibility of Field Service Product Management.

Picture of actual product.

1.1 EXECUTIVE SUMMARY

1.1.1 Plan Summary

Brief description of product, marketing, and service strategy.

1.1.2 Business Impact Statement
1.1.3 Key and critical Items

1.2 SERVICE BUSINESS PLAN AND ANALYSIS

Consists of business goals and objectives, strategies to meet goals, Field Service pricing form, 5–year profit/loss statement, with break–even quarter, and the process used to measure goals.

1.3 FINANCIAL ANALYSIS

Consists of Life Cycle Business Management (LCBM) market Basic Monthly Charge (BMC) runs, LCBM sensitivity runs, CSSE cost–driven LCBM runs, and technical risks.

2.0 MARKETING PLAN AND ANALYSIS

Consists of 5–year projected product sales; service products offered; any special requirements, terms or conditions; identified hardware delivery channels; and identified markets in which Digital is competing.

Also lists promotional schemes and defines major accounts, if available.

3.0 SERVICE OPERATIONS PLAN

Responsibility of CSSE.

Include a product description and block diagram, and describe architecture, as applicable. Describe physical characteristics, service features, and configuration diagram.

3.1 PRIMARY SERVICE PLAN

Initial service delivery, product repair strategy, remote diagnosis features available, maintenance goals, such as MTBF and MTTR, preventive maintenance, environmental and power requirements, physical layout, installation and acceptance procedures, service engineer profile and skill set, tools and test equipment requirements, documentation, diagnostics, software, and data collection methodology.

3.2 SUPPORT SERVICE PLAN

Support strategy, revision control/compatibility, tools and skills required, test equipment and service aids, support level documentation.

3.3 LOGISTICS PLAN

Strategy, RSL/ARL repair source identification, kit information, field ordering information, kit/option ratio, kit availability, FRU repair sources and cost, loose piece ordering information, option swap, capital equipment, test equipment, tools, look-alike strategy, material feedback plan, warranty plan, and logistics flow.

3.4 SERVICE TRAINING PLAN

Responsibility of the Training Project Manager.

Focuses on service delivery methods, strategy, population, prerequisites, student volumes, first level and support level training, documentation, and implementation.

HARDWARE CUSTOMER SERVICES PRODUCT PLAN OUTLINE (continued)

3.5 CUSTOMER TRAINING

Responsibility of the Training Project Manager.

3.6 CONTINUATION ENGINEERING

Responsibility of CSSE.

Includes FCO strategy.

4.0 SERVICE DELIVERY

Responsibility of Field Service Product Management.

Include service delivery method, problem management system, pre–contract inspection, option level swap strategy, escalation procedures, and revision management.

5.0 OPERATIONS AND ADMINISTRATION

Responsibility of Field Service Product Management

Include business reporting and measurements, call administration and labor reporting, warranty administration, warranty terms and conditions, contract administration, revenue tracking, and billing requirements.

6.0 MISCELLANEOUS ATTACHMENTS

Responsibility of Field Service Product Management

Include pre–contract inspection form, key contacts for field, references, and environmental specifications.

7.5.3 Customer Services Product Phase Down Plans (Phase 4B)

OVERVIEW

NOTE

The following overview applies to the three plans outlined in this section:

- Customer Services Hardware Product Phase Down Plan – High–Impact Products
- Customer Services Hardware Product Phase Down Plan – Low–Impact Products
- Customer Services Software Product Phase Down Plan – All Products

Purpose:

The purpose of a Product Phase Down Plan is to document the Customer Services Phase Down commitment for the product to be retired from sales, and to plan for ongoing support. The Customer Services Product Planning Process is the communications vehicle used by the various Customer Services groups responsible for ensuring congruency between Customer Services delivery strategies and PBU product strategies.

All Customer Service Product Phase Down Plans include:

- Executive Summary
- Service Offerings
- Geographical Impact
- Business Strategy
- Product Support Planning

CUSTOMER SERVICES PRODUCT PHASE DOWN PLANS OVERVIEW (continued)

Audience:

- Customer Services Geography Planning and support groups
- Manufacturing Planning
- Product Management
- Marketing
- Sales

Who is Responsible:

The Customer Services representative on the Product Team, with inputs from representatives from the organizations listed below, depending on product type:

- CSSE
- Educational Services
- Field Service Logistics
- Software Services
- Geography Planning Groups (U.S., Europe, GIA)

When Required:

The Product Phase Down Plan must be completed by Phase 4B Exit.

CUSTOMER SERVICES PRODUCT PHASE DOWN PLANS OVERVIEW (continued)

Relationship To Other Activities:

This plan is the Customer Services' input to the Corporate Phase Review Process.

Where Recorded:

Customer Services Systems Engineering (CSSE) New Product Planning

CUSTOMER SERVICES HARDWARE PRODUCT PHASE DOWN PLAN – HIGH IMPACT PRODUCTS OUTLINE

COVERSHEET

Include name, date, organization, and revision. Label **Digital Internal Use Only** at the bottom as shown in the following example:

CUSTOMER SERVICES

Product Phase Down Cover Sheet

Name:

Date:

Organization: Revision:

FOR DIGITAL INTERNAL USE ONLY

CUSTOMER SERVICES HARDWARE PRODUCT PHASE DOWN PLAN – HIGH IMPACT PRODUCTS OUTLINE

FOREWORD

Purpose of document.

1.0 EXECUTIVE SUMMARY

Limited to one page. Includes: problem statement, highlights, background information, conclusion, and recommendations.

2.0 OVERVIEW

- Brief description of product, including models.
- Responsibilities of Team members (Customer Services Team)
- Phase down schedule
- Migration strategy

CUSTOMER SERVICES HARDWARE PRODUCT PHASE DOWN PLAN – HIGH IMPACT PRODUCTS OUTLINE (continued)

3.0 FIELD SERVICE PRODUCT PHASE OUT OBJECTIVES

Field Service standard service offerings with emphasis on changes required to support the PBU business strategy.

- Material (spares) objective
- Customer satisfaction
- Financial 5–year forecast
  - Contract volume
  - Service NOR
  - MSE
  - Contribution margin %
  - Geographical distribution

4.0 BUSINESS STRATEGY (Hardware or Software Product Strategy)

Product migration strategy (from PBU Product Manager). If SPS/SSC or FSPPC proposals will be made to obtain approval for the product's phase down strategy, show key highlights.

- FSPPC proposal highlights
- Key accounts (from PBU and FS Product Manager)
- Service offering (by area business support groups)
- Current
- Proposed
- Geographical impact
- Contingency plans

5.0 PRODUCT SUPPORT PLANNING (HARDWARE AND SOFTWARE)

5.1 LOGISTICS PLAN

5.2 TRAINING PLAN

- Customer
- Internal

5.3 DOCUMENTATION PLAN

5.4 PRODUCT MGMT PLAN (PBU AND FS)

5.5 REMEDIAL PLAN FOR FUTURE

- Software Problem Report (SPR)
- Software telephone support
- Software technical back up
- Hardware design problems
- Problem Resolution and Information Systems Management (PRISM)
- Common Log Desk (CLDs)
- Diagnostics
- Field Change Order/Engineering Change Order (FCO/ECO)

6.0 CONCLUSION/RECOMMENDATIONS

6.1 CONCLUSION

- Business opportunities/directions (customer impact)
- Risk and dependencies
- Commitment to review service offerings

6.2 RECOMMENDATION

- Service offerings
- Alternative solution(s)
- Schedules for phase down of standard service offerings

7.0 COMMUNICATIONS STRATEGY

- Field Implementation Plan (FIP)
- Planning Automated Support System (PASS)
- SALES UPDATE
- DEC STUFF
- Other

8.0 REFERENCES

Other plans for further information:

Manufacturing Phase Down Plan
Marketing Migration Plan
Sales Phase Down Plan
Corporate Phase Down Plan

CUSTOMER SERVICES HARDWARE PRODUCT PHASE DOWN PLAN – LOW IMPACT PRODUCTS OUTLINE

1.0 PRODUCT–SPECIFIC INFORMATION

1.1 PRODUCT DESCRIPTION
1.2 PBU PRODUCT MANAGEMENT (Long–Term Plan)
1.3 MIGRATION STRATEGY
1.4 PRODUCT PHASE DOWN SCHEDULE

2.0 SERVICE–SPECIFIC INFORMATION

2.1 FIELD SERVICE PRODUCT PHASE DOWN PHILOSOPHY
2.2 CUSTOMER SERVICE TEAM MEMBERS
2.3 LOGISTICS PLAN

- Service Life Cycle Forecast
- Self–Maintenance Support

2.4 TRAINING PLAN
2.5 DOCUMENTATION PLAN
2.6 PRICING PLAN

- Common Log Desk/Problem Resolution and Information Systems Management (CLD/PRISM)
- ECO/FCO
- Design Problems (Long–Term Engineering Support Plan)
- Diagnostics
- Contingency Plans/Risks

2.7 COMMUNICATIONS PLAN

3.0 CONCLUSIONS/RECOMMENDATIONS

CUSTOMER SERVICES SOFTWARE PRODUCT PHASE DOWN PLAN – ALL SOFTWARE PRODUCTS OUTLINE

FOREWORD—PURPOSE OF DOCUMENT

Statements about Field Service retirement philosophy, the audience of the document, and why Customer Services input is important to the decision making process. (1–2 paragraphs)

1.0 OVERVIEW

1.1 PRODUCT DESCRIPTION
1.2 RETIREMENT DECISION BASIS
1.3 OTHER PRODUCT DEPENDENCIES
1.4 MIGRATION STRATEGY
1.5 PHASE DOWN SCHEDULE

Note: The above information is found in documents produced by the PBU Product Manager. Topics are listed here to put the plan in context.

2.0 FIELD SERVICE PRODUCT PHASE DOWN INPUTS

2.1 CURRENT SERVICE OFFERINGS BY GEOGRAPHY

2.2 CURRENT CONTRACT VOLUMES BY GEOGRAPHY

2.3 SERVICE NET OPERATING REVENUE (NOR) OR OTHER AVAILABLE APPROPRIATE FINANCIALS

2.4 SSC OR FSPPC APPROVALS REQUIRED, SCHEDULED DATES, PROPOSAL HIGHLIGHTS (if applicable)

2.5 KEY SPS ACCOUNTS, GOVERNMENT OBLIGATIONS

2.6 IMPACT OF OTHER PRODUCT DEPENDENCIES ON SERVICES

2.7 SUMMARY OF IMPACT STATEMENTS FROM THE GEOGRAPHIES (if available)

This information is the Service Product Manager's portion of the Phase Down Plan and is the Field Service input to the decision–making process.

3.0 PRODUCT SUPPORT PLANNING

3.1 REMEDIAL SUPPORT OBLIGATIONS

- Outstanding SPRs
- Outstanding CLDs/PRISMs
- Estimated End of Service Date

3.2 ANY CHANGES RECOMMENDED IN CURRENT SUPPORT STRATEGY
3.3 SERVICE CONTRACT MIGRATION STRATEGY IF APPLICABLE
3.4 TRAINING INFORMATION TO BE ARCHIVED
3.5 PASS RETIREMENT DOCUMENT NUMBER
3.6 CUSTOMER SERVICES TEAM MEMBERS

This is the Maintainability Engineer/Planner side of the information. It is a reminder to the PBU of the obligations that they are required to fulfill before support can end, as well as a summary of the information that CSSE is sending to the Field.

4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 ISSUES/RISKS/DEPENDENCIES/OPPORTUNITIES/OTHER
4.2 CSSE IMPACT ASSESSMENT AND RECOMMENDATION FOR OR AGAINST RETIREMENT

Appendix A

DIGITAL STANDARDS REQUIREMENTS BY PHASE

DIGITAL STANDARDS REQUIREMENTS BY PHASE

This table indicates at which phase of the Phase Review Process compliance with individual Digital Standards is required. Digital Standards are mandatory because of legal requirements, Corporate responsibilities, and liabilities. Some standards are unique to the design of subassemblies, backplanes, modules and compliance is expected. The following keys identify basic information which must documented for any Digital Standard as Phase Exit requirements.

KEY	DESCRIPTION OF DEC STANDARD EXIT REQUIREMENTS
1	Confirm that the Digital Standard is applicable as a requirement for the product, **or** Provide evidence to justify that it is not applicable.
2	Confirm that all the requirements of the Digital Standard are to be incorporated in the product, **or** Provide evidence to justify designing the product to a lesser capability.
3	Confirm (show schedule or plan) that completion of the requirements of the Digital Standard are scheduled.
4	Confirm (provide evidence, such as test reports and agency approvals) that all requirements of the Digital Standard have been met, **or** Provide evidence (formal waiver per DEC STD 066–2) that formal waivers are complete for any non–compliance which are not to be resolved.

Table A–1: TECHNICAL DOMAINS AND COUNTRY REQUIREMENTS

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
002–0	1,2	3	4		
002–1	1,2	3	4		
012–0		1			
012–1		1			
012–2		1			
025–0			1		
047–0		2			
047–1		2			
052–0	1	2		4	
052–1	1	2		4	
052–2	1	2		4	
052–3	1	2		4	
052–4	1	2		4	
053–0	1	2		4	
053–1	1	2		4	
060–0	1,2				
062–0	1,2				
064–0	1,2	3	4		
066–0	1,2	3	4		
066–3	1,2	3	4		
068–0			1		
071–0		1			
080–0	1,2	3			
080–1	1,2	3	4		
080–2			4		
100–0				1	
102–0	1	2	3	4	
102–1	1	2	3	4	
102–2	1	2	3	4	

Table A–1 (Cont.): TECHNICAL DOMAINS AND COUNTRY REQUIREMENTS

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
102–3	1	2	3	4	
102–4	1,2	3		4	
103–0	1,2	3		4	
104–0	1,2	3		4	
105–0	1,2	3	4		
119–0	1,2	3			
119–1	2	3		4	
119–2			4		
119–5	1				
122–0	1,2	3		4	
123–0	1,2	3		4	
136–0	1	2	3	4	
136–3	1	2	3	4	
178–1		1,2	3	4	
178–2		1,2	3	4	
178–3		1,2	3	4	
178–4		1,2	3	4	
178–5		1,2	3	4	
178–6		1,2	3	4	
178–7		1,2	3	4	
178–8		1,2	3	4	
178–9		1,2	3	4	

Table A-2: TERMINALS REQUIREMENTS

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
070–0	1,2	3	4		
107–0	1				
107–1	1,2	3	4		
107–2	1,2	3	4		
180–0	1,2	3	4		

Table A-3: HARDWARE ARCHITECTURE REQUIREMENTS

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
032–0		1	2,3	4	4
057–0	1,2		3	4	

Table A-4: CROSS-ARCHITECTURAL REQUIREMENTS

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
049–0	1,2	3	4		
138–0	1,2	3	4		
164–0	1,2	3	4		
169–0	1,2	3	4		
169–1	1,2	3	4		

Table A–5: DIGITAL NETWORK ARCHITECTURE

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
134–0	1	2,3			4
161–0	1	2,3		4	
200–0	1	2,3		4	
200–1	1	2,3		4	
200–2	1	2,3		4	
200–3	1	2,3		4	
200–4	1	2,3		4	
200–5	1	2,3		4	
200–7	1	2,3		4	
200–10	1	2,3		4	
200–11	1	2,3		4	

Table A–6: PROCESS AND DESIGN TECHNOLOGY

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
020–0		1,2			
022–0		1,2			
022–1		1,2			
030–0		1,2	4		2
030–1		1,2	4		2
030–2		1,2	4		2
030–3		1,2	4		2
030–4		1,2	4		2
030–5		1,2	4		2
030–6		1,2	4		2
030–7		1,2	4		2
030–8		1,2	4		2
030–9		1,2	4		2
030–10		1,2	4		2
043–0		2,3	4		

Table A–6 (Cont.): PROCESS AND DESIGN TECHNOLOGY

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
043–1		2,3	4		
044–0		1	2	3,4	4
045–0		2	3		
045–1		2	3		
048–0		1,2	3	4	
055–0		1	2	3,4	4
056–0	1	2	3	4	
056–3	1	2	3	4	
056–5	1	2	3	4	
072–0			1		
076–0		1,2	3	4	
092–0		1,2			
092–1		1,2			
092–2		1,2			
092–3		1,2			
092–4		1,2			
092–5		1,2			
092–6		1,2			
092–7		1,2			
120–0		1,2	3	4	
131–0		1,2			3,4
136–1		1	2	3	
156–0	1	2	3	4	
179–0		1,2			
186–0		1,2	3	4	
187–0					4

Table A–7: PRODUCT PERFORMANCE TESTING

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
038–0	1	2,3	4	4	
038–1	1	2,3	4	4	
038–2	1	2,3	4	4	
139–0		1,2	3,4		

Table A–8: MAINTENANCE AND INSTALLATION REQUIREMENTS

DEC STD	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
009–1		1	3	4	
009–2	2,3	4			
117–0	1,2				

Appendix B

REFERENCED AND RELATED DOCUMENTS

EL–CLASS DIGITAL DOCUMENTS

EL–Class Number	Document Title
EL–00002–00	*DEC STD 002–0 AC Power Wiring, Safety Earth Grounding, Plugs and Receptacle Information and Requirements*
EL–00002–01	*DEC STD 002–1 Power Controller Units – General Requirements*
EL–00009–01	*DEC STD 009–1 Product Engineering Specifications: Electrical, Physical, and Environmental Parameters*
EL–00009–02	*DEC STD 009–2 Product Engineering Specifications: Requirements for Specifying Reliability Parameters*
EL–00012–00	*DEC STD 012–0 Part Identification Standard*
EL–00012–01	*DEC STD 012–1 Unified Numbering Code: Document Identification Conventions*
EL–00012–02	*DEC STD 012–2 Unified Numbering Code for Part Identifier class codes*
EL–00012–04	*DEC STD 012–4 Unified Numbering Code – Software Distribution Center Part Numbering Conventions*
EL–00020–00	*DEC STD 020–0 Cast Metal Parts*

EL–Class Number	Document Title
EL–00022–00	*DEC STD 022–0 Cable and Harness Documentation: Part Identification Requirements*
EL–00022–01	*DEC STD 022–1 Cable and Harness Documentation: Drawing Requirements*
EL–00025–00	*DEC STD 025–0 Parts Lists*
EL–00028–00	*DEC STD 028–0 Phase Review Policy*
EL–00030–00	*DEC STD 030–0 Module Manufacturing Standard – Introduction And General Information*
EL–00030–01	*DEC STD 030–1 Module Manufacturing Standard – General Producibility Requirements*
EL–00030–02	*DEC STD 030–2 Module Manufacturing Standard – Product Safety Requirements*
EL–00030–03	*DEC STD 030–3 Module Manufacturing Standard – Component Selection Rules*
EL–00030–04	*DEC STD 030–4 Module Manufacturing Standard – Printed–Wiring Board Design Requirements*
EL–00030–05	*DEC STD 030–5 Module Manufacturing Standard – Module Assembly And Component Insertion Rules*
EL–00030–06	*DEC STD 030–6 Module Manufacturing Standard – Bare Board and Module Testability Rules*
EL–00030–07	*DEC STD 030–7 Module Manufacturing Standard – Backplane Rules and Related Factors*
EL–00030–08	*DEC STD 030–8 Module Manufacturing Standard – Rules for Power Supplies and Nonplug–In Modules*
EL–00030–09	*DEC STD 030–9 Module Manufacturing Standard – Surface Mount Technology Design Rules*
EL–00030–10	*DEC STD 030–10 Module Manufacturing Standard – Footprint Patterns for Surface Mount Technology*
EL–00032–00	*DEC STD 032–0 VAX Architecture Standard*
EL–00038–00	*DEC STD 038–0 System Evaluation of New Products – General*
EL–00038–01	*DEC STD 038–1 Systems Evaluation of New Products – Software*
EL–00038–02	*DEC STD 038–2 Systems Evaluation of New Products – Hardware*

EL–Class Number	Document Title
EL–00043–00	*DEC STD 043–0 Packaging Requirements for Digital Products, Parts, Assemblies, and Materials*
EL–00043–01	*DEC STD 043–1 Packaging Requirements – Sheets, Blanks, or Coils of Steel or Aluminum*
EL–00044–00	*DEC STD 044–0 Packing Documentation Requirements*
EL–00045–00	*DEC STD 045–0 Packaging Products for International Shipment – Introduction*
EL–00045–01	*DEC STD 045–1 Standard for Packaging Products for International Shipment – Design Requirements and Procedures*
EL–00047–00	*DEC STD 047–0 Bar Code Symbology Criteria*
EL–00047–01	*DEC STD 047–1 Physical Requirements for Bar Coding*
EL–00048–00	*DEC STD 048–0 Metallic Raw Material Selection and Identification*
EL–00049–00	*DEC STD 049–0 Document Transmission (DX) Protocol*
EL–00052–00	*DEC STD 052–0 Operational Requirements for Serial Terminals And Computer Interfaces Operating as DTEs Connected to EIA RS-232-C Or CCITT V.28 Modems*
EL–00052–01	*DEC STD 052–1 Operational Requirements for Serial Terminals And Serial System Interfaces Operating as DTEs Connected to EIA RS–232–C Or CCITT V.*
EL–00052–02	*DEC STD 052–2 Electrical Requirements for Binary Interfaces That Conform to EIA RS–232–C Or CCITT V.28 Modems*
EL–00052–03	*DEC STD 052–3 Automatic Calling and/or Answering Equipment On The GSTN Using The 100 Series Interchange Circuits*
EL–00052–04	*DEC STD 052–4 Local Direct Connection (No Modem) for Serial Asynchronous Terminals and System Interfaces*
EL–00053–00	*DEC STD 053–0 Interface Between Data Circuit–Termination Equipment and Public Switched Telephone Network (PSTN) In The U.S. and Canada*
EL–00055–00	*DEC STD 055–0 Requirements for Purchase Specifications*
EL–00056–00	*DEC STD 056–0 Symbology – Circuit Schematic Requirements*

EL–Class Number	Document Title
EL–00056–03	*DEC STD 056–3 Symbology – Discrete Electronic And Electromechanical Component Symbols*
EL–00056–05	*DEC STD 056–5 Industry Standard Logic Symbols and Diagrams*
EL–00057–00	*DEC STD 057–0 VAXBI Standard*
EL–00060–00	*DEC STD 060–0 Design of Hardware Products to National And International Regulations and Standards, Policies and Responsibilities*
EL–00062–00	*DEC STD 062–0 Product Submittal to Regulatory Agencies*
EL–00064–00	*DEC STD 064–0 Compliance With International Language Requirements*
EL–00066–00	*DEC STD 066–0 Digital Design Standards*
EL–00066–01	*DEC STD 066–1 Technical Domains In The Product Development Process*
EL–00066–02	*DEC STD 066–2 Waivers to Digital Design Standards*
EL–00066–03	*DEC STD 066–3 Policy for Designing Products for All Countries Designated as Strategic Markets*
EL–00068–00	*DEC STD 068–0 Policy for Documentation of Revision Levels Of Units and Combinations of Units*
EL–00070–00	*DEC STD 070–0 Video Systems Reference Manual*
EL–00071–00	*DEC STD 071–0 Field Change Order Policy – Introduction*
EL–00072–00	*DEC STD 072–0 POM (Point of Manufacture) Review Criteria*
EL–00073–00	*DEC STD 073–0 Manufacturing and Packaging for Publications*
EL–00076–00	*DEC STD 076–0 Plastics Selection and Identification*
EL–00080–00	*DEC STD 080–0 Digital Product Safety Industrial Control Equipment–Introduction and General Requirements*
EL–00080–01	*DEC STD 080–1 Digital Product Safety Industrial Control Equipment – Design Criteria*
EL–00080–02	*DEC STD 080–2 Digital Product Safety Industrial Control Equipment – Test Methods*
EL–00092–00	*DEC STD 092–0 Finish and Color Standard – Introduction and General Requirements*

EL–Class Number	Document Title
EL–00092–01	*DEC STD 092–1 Finish and Color Standard – Finish Standard for Applications*
EL–00092–02	*DEC STD 092–2 Finish and Color Standard – Finish Material Standard for Suppliers*
EL–00092–03	*DEC STD 092–3 Finish and Color Standard – Finish Material Test Requirements*
EL–00092–04	*DEC STD 092–4 Finish and Color Standard – Approved Finish Specifications*
EL–00092–05	*DEC STD 092–5 Finish and Color Standard – Digital Color List*
EL–00092–06	*DEC STD 092–6 Finish and Color Standard – Digital–Approved Paint Suppliers and Material Identification*
EL–00092–07	*DEC STD 092–7 Finish and Color Standard– Plastic Color Control and Material Identification*
EL–00100–00	*DEC STD 100–0 Introduction to Engineering Change Orders*
EL–00100–1C	*DEC STD 100–1C Engineering Change Orders – Financing ECOs to Hardware*
EL–00102–00	*DEC STD 102–0 Environmental Standard for Computers and Peripherals – General Test Requirements*
EL–00102–01	*DEC STD 102–1 Environmental Standard for Computers and Peripherals – Temperature, Humidity, and Altitude Test Requirements*
EL–00102–02	*DEC STD 102–2 Environmental Standard for Computers and Peripherals – Mechanical Shock and Vibration Test Requirements*
EL–00102–03	*DEC STD 102–3 Physical Stability Requirements During Shipping and Handling*
EL–00102–04	*DEC STD 102–4 Environmental Standard for Computers and Peripherals – Product Acoustic Noise Measurement*
EL–00103–00	*DEC STD 103–0 Electromagnetic Compatibility (EMC) Hardware Design Requirements*
EL–00104–00	*DEC STD 104–0 Product Acoustic Noise Acceptability*
EL–00105–00	*DEC STD 105–0 Display Work Station Ergonomics (Human Factors): Design Criteria*
EL–00107–00	*DEC STD 107–0 Digital Standard for Terminal Keyboards Standard Keyboard Layouts*

EL–Class Number	Document Title
EL–00107–01	*DEC STD 107–1 Digital Standard for Terminal Keyboards – Registry of Graphic Character Sets*
EL–00107–02	*DEC STD 107–2 Digital Standard for Terminal Keyboards – LK201 Character Sets*
EL–00117–00	*DEC STD 117 Print Sets*
EL–00119–00	*DEC STD 119–0 Digital Product Safety – Introduction and General Requirements*
EL–00119–01	*DEC STD 119–1 Digital Product Safety – Design Criteria*
EL–00119–02	*DEC STD 119–2 Digital Product Safety – Test Procedures*
EL–00119–05	*DEC STD 119–5 Process for Design, Evaluation, Testing, and Certification of Hardware Products to Product Safety Requirements*
EL–00120–00	*DEC STD 120–0 Cooling Standard*
EL–00122–00	*DEC STD 122–0 AC Power Line Standard: Design Requirements and Guidelines*
EL–00123–00	*DEC STD 123–0 Power Control Bus Standard*
EL–00130–00	*DEC STD 130–0 Product/System Business Plans: Content Requirements And Format Guidelines*
EL–00131–00	*DEC STD 131–0 Traceability Policy*
EL–00134–00	*DEC STD 134–0 Digital CSMA/CD (Ethernet) Local Area Network Specification*
EL–00136–00	*DEC STD 136–0 Digital Policy On Government–Regulated Materials in Digital Products*
EL–00136–01	*DEC STD 136–1 Digital Policy on Government–Regulated Materials In Digital's Manufacturing Processes*
EL–00136–03	*DEC STD 136–3 The Introduction and Review Process For Digital Chemical Products*
EL–00138–00	*DEC STD 138–0 Registry of Control Functions for Character Imaging Devices*
EL–00139–00	*DEC STD 139–0 Reliability Prediction*
EL–00156–00	*DEC STD 156–0 Introduction of New Purchased Parts and Maintenance of Purchased Parts Information: Standard Procedures*
EL–00161–00	*DEC STD 161–0 Computer Interconnect Specification*

EL-Class Number	Document Title
EL-00164-00	*DEC STD 164-0 Software Use of the Graphic Character Set of ASCII*
EL-00169-00	*DEC STD 169-0 DEC Standard Coded Graphic Character Sets for Hardware and Software*
EL-00169-01	*DEC STD 169-1 DEC Standard Coded Graphic Character Sets for Hardware and Software: Introduction*
EL-00178-00	*DEC STD 178-0 Digital Identification Marking Requirements – Introduction*
EL-00178-01	*DEC STD 178-1 Digital Marking Requirements For Piece Parts*
EL-00178-02	*DEC STD 178-2 Digital Marking Requirements For Subassemblies: Field Replaceable Units (FRU) and Non-Field Replaceable Units*
EL-00178-03	*DEC STD 178-3 Digital Marking Requirements for Completed Products Intended to be Sold*
EL-00178-04	*DEC STD 178-4 Container Marking Equirements for Finished Goods*
EL-00178-05	*DEC STD 178-5 Marking Symbology*
EL-00178-06	*DEC STD 178-6 Marking and Labeling Requirements for Diagnostic Tools and Diagnostic Software*
EL-00178-07	*DEC STD 178-7 Translations*
EL-00178-08	*DEC STD 178-8 General Shipping Documentation and Container Labeling Requirements for Finished Goods Intended to Be Shipped To Customers*
EL-00178-09	*DEC STD 178-9 Shipping Container Marking Requirements For Goods In Process*
EL-00179-00	*DEC STD 179-0 Requirements for Specifying Raw Materials for Powder-Metal Parts*
EL-00180-00	*DEC STD 180-0 Standard for Font File Identification*
EL-00186-00	*DEC STD 186-0 Signal Integrity*
EL-00187-00	*DEC STD 187-0 Mechanical Fabrication Workmanship Standards*
EL-00197-00	*DEC STD 197-0 Legal Requirements and Guidelines for Digital Publications and Software*
EL-00200-00	*DEC STD 200-0 Digital Network Architecture Process Specification*

EL–Class Number	Document Title
EL–00200–01	*DEC STD 200–1 Digital Network Architecture – Maintenance Operations Functional Specification*
EL–00200–02	*DEC STD 200–2 Digital Network Architecture – Network Management Functional Specification*
EL–00200–03	*DEC STD 200–3 Digital Network Architecture – Ethernet Node Product Architecture Specification*
EL–00200–04	*DEC STD 200–4 Digital Network Architecture – NSP Functional Specification*
EL–00200–05	*DEC STD 200–5 Digital Network Architecture – Routing Layer Functional Specification*
EL–00200–07	*DEC STD 200–7 Digital Network Architecture – Session Control Functional Specification*
EL–00200–10	*DEC STD 200–10 Digital Data Communications Message Protocol (DDCMP)*
EL–00200–11	*DEC STD 200–11 Digital Network Architecture – Ethernet Data Link Functional Specification*
EL–CPPAC–00	*Corporate Policies for Product Pricing, Announcement, and First Customer Ship*
EL–CP595–00	*Corporate Product Introduction Guide*
EL–CP596–00	*Phase Exit Guidebook – Top 100 Products*
EL–MF028–00	*Administration Policies and Procedures – Product Phase Down Policy*
EL–CP060–01	*Design and Certification of Hardware Products to National and International Regulations and Standards – Specific Requirements*
EL–MF356–00	*Manufacturing Systems Program Manager (MSPM) – Guide*
EL–MF356–01	*Finance Phase Review Guidelines*
EL–MF356–02	*Information Systems Phase Review Guidelines*
EL–MF356–03	*Manufacturing Engineering Phase Review Guidelines*
EL–MF356–04	*Corporate Materials Architecture New Products Module Material Phase Review Process*
EL–MF356–05	*Manufacturing Order Administration Phase Review Guidelines*
EL–MF356–06	*Materials Engineering Domain Phase Review Guidelines*
EL–MF356–07	*Phase Review Production Guidelines*

EL–Class Number	Document Title
EL–SM498–00	*Producing International Products*
EL–EN522–00	*Digital Qualification Process Manual* (Currently in Review)
EL–MF540–00	*Product Phase Down/End of Life Guidelines*

Copies of Digital EL–Class documents may be obtained from Standards and Methods Control, CTS1–2/D4, DTN: 287–3724, JOKUR::SMC.

Please provide your name, mail stop, cost center, badge number, and node address when ordering.

GLOSSARY

8–Quarter Volume Planning Process (8QVP)

A process and document that establishes one source for Corporate volume requirements.

Alternatives and Feasibility Study

A study to determine the benefits and costs, in terms of time, money and manpower, of the development of a proposed product, resulting with a recommendation or proposed alternatives.

Announcement Strategy Committee (ASC)

A subcommittee of the Marketing, Sales, and Strategy Committee (MSSC) that develops and manages integrated introduction plans for strategic products and sponsors them to MSSC for approval. Creates Corporate Announcement Calendar for MSSC approval. Recommends product names to MSSC.

Applications Review Board (ARB)

Committee that evaluates software developers who sell their software applications separately from, but for execution on, Digital systems. The software developers must meet standard criteria on both service and technical issues before they can be approved by the ARB Committee.

Application Software Solutions and Expertise Transfer Service (ASSETS)

A library of software packages used as a foundation to create customer solutions.

Approval

The term "approval" is used primarily in association with documents (plans, requirements statements, and specifications) and indicates that the document has been written, reviewed, and approved by the delegated responsible individual(s).

Assumptions Package

The Assumptions Package includes:

- Market requirements
- First pass product requirements including product description (final product requirements will include functional requirements input)
- Alternatives and Feasibility Study
- Assumptions:
  - Volume projections
  - Announcement and First Revenue Ship (FRS) dates
  - Major goals (such as, time–to–market, cost, availability)

Automatic Distribution System (ADS)

System containing names of individuals, both customer and internal, and the software products or diagnostics for which they wish to receive updates.

Availability

Availability is a fraction showing the time that a unit or system is available for use during the intended usage period divided by the intended usage period. It is sometimes expressed as a percentage. How long a gap in functionality is counted as non–availability and how much of a system needs to be down before non–availability is counted needs to be defined in every circumstance.

Baselevel

A baselevel is the set of all documents and files that comprise a specific version of a product created at a specific time. All files in the baselevel are in their latest "built" and tested states from which it is usually possible to generate a working system.

Baselevel build

A baselevel build is the entire process of creating a new baselevel and performing a baselevel release. This includes building the total product from its source files, performing regression tests, collecting new baselevel test procedures, and releasing the new baselevel.

Baselevel release

The baselevel release is the process of replacing the current baselevel with the new and regression–tested baselevel. The baselevel release will also include submitting the new baselevel to the library for archival storage.

BOM

Acronym for Bill of Materials. The Bill of Materials for a product defines the component parts of the product. It is a complete list of component parts and materials making up one unit of an end item. The standard cost of each component multiplied by the quantity is totaled in order to calculate the cost.

Business Plan

The Business plan is a comprehensive set of business metrics designed to evaluate the potential of a new product, in a format that permits comparison to other products. The Business plan is used to review the product strategy, business viability, and required investments. The business plan is updated during each phase and summarizes phase activities. (See *DEC STD 130 Product/System Business Plans: Content Requirements and Format Guidelines.*)

Change Control

The process by which a change is proposed, evaluated, approved or rejected, scheduled, and tracked.

Common Log Desk (CLD)

Field Service procedure to handle the highest level of customer support problems. Individual is assigned responsibility to remedy the situation.

Complete

Term used in *DEC STD 028 Corporate Phase Review Policy* to indicate that Phase Exit documents have been written, reviewed, distributed and approved by the delegated responsible individuals.

Corporate Export and Trade (CE/T)

Corporate Export and Trade (CE/T), Washington D.C. – CE/T is responsible for determining how U.S. Government regulations impact Digital products and services. CE/T will review the product, determine appropriate government classification under the current export regulations, and advise the Product Manager of the conditions under which the product may be exported. The Product Manager is requested to provide CE/T with a summary product description an overview of the target markets, estimated month of announcement, and initial date feedback is required. CE/T contact focal point is Don Ames. See ELF.

Corporate Process Task Force (CPT)

Among its other responsibilities of developing strategies and architectures to integrate the information of knowledge processes in Engineering, Manufacturing and the Field, the CPT membership serves as a repository of information and consultation on Methods and Tools in these domains. In addition to the expertise of direct members of CPT (all senior process experts), access is available, through CPT, to Computer Aided Design (CAD), (CIM) and Artificial Intelligence (AI) experts.

In addition to advice and consulting, CPT and its subgroups (CAD Forum, Test Track, Computer Intergrated Manufacturing (CIM) Forum) has assembled a Corporate_CAD_Tool_Directory and documented examples of working design methods which can be shared on request.

For further information, contact Eli Glazer or Tony Hutchings. See ELF.

Corporate Product Operations (CPO – Sales)

CPO is responsible for managing major product introductions worldwide, Field Product Strategy and volume planning, product pricing, competitive positioning and messages, Proprietary Information Disclosure to potential customers, post announcement programs, and product business problem resolution.

Country List Price (CLP)

Term replacing Maynard List Price which is the price of a product that Digital customers would pay for a product; Country List Price includes uplift.

Customer Services

Consists of Field Service, Software Services, and Educational Services.

Customer Services Phase Down Plan

The Services plans and commitments to phase down service for the product.

Customer Services Plan

The Services Plan for products that is a Phase 1 through Phase 3 deliverable to the Program Team. It includes the Services plans, activities, and commitments to service the product.

Customer Services Systems Engineering (CSSE)

A Field Service organization primarily responsible for providing:

- Defined levels of service engineering
- Corporate support of all products
- Technical information
- Service Product Management
- Service Product Marketing
- Field introductions

DECUS

Digital Equipment Computer Users Society

Design Specification

Translation of the functional specifications into detailed technical parameters that are used by Development Engineering to define and execute the work necessary to create a product with the required functional characteristics.

Design Verification Testing (DVT)

- Design complete
- Simulation complete, timing has been verified
- Build prototype/software functional code freeze
- All features tested in at least one configuration that is in the customer environment, for example, CPU runs all instructions at speed with a given operating system

DEC STUFF

DEC STUFF is a technical newsletter published monthly by CSSE Publications. It is a means by which CSSE Maintainability Engineering distributes remedial information to field support personnel. Some examples are VAX STUFF, RIGHT STUFF, MICRO STUFF, and VES STUFF (Vendor Equipment Systems).

Digital Business Agreement (DBA)

Contract a customer signs with Digital to purchase a certain amount of Digital's products that makes the customer eligible for discounts on those products.

Documentation

A collection of written descriptions and procedures that provide information and guidance for all or part of a computer system, so that it can be properly installed, used and serviced.

Documentation Plan

The documentation plan is a document which describes in detail the activities, the time to complete the activities and the resources required to complete a documentation project. The documentation plan also provides a detailed outline of the information that is to be written for a product and usually covers one or all of the following aspects of the product: installation, use, service.

Domain Manager

See *DEC STD 066–0 Digital Design Standards.*

Educational Services

Customer Services organization responsible for both customer and internal technical training.

Educational Services Strategies and Requirements Document

Educational Services document that includes the training strategy and requirements needed to develop the training required to support the product. It is a Phase 1 document.

Engineering Change Order (ECO)

A formal change to the product or its documentation to correct a problem, or add additional functionality or information. See *DEC STD 100–0 Introduction to Engineering Change Orders.*

Exit Criteria

Major requirements that must be completed prior to proceeding to the next phase of a product's life cycle.

Field Change Order (FCO)

Implementation of an ECO in the installed customer base. Process used by Field Service to implement engineering change modifications.

Field Implementation Plan (FIP)

A geography–specific Field Service Plan which contains information needed to support a product in a particular geography.

Field Launch Committee (FLC)

A subcommittee of ASC; participates in the development and implementation of field introduction plans, as documented in the Corporate Introduction Plan.

Field Replaceable Unit (FRU)

A unit of a system's structure which can be readily removed and replaced at a customer site.

Field Service (FS)

The Customer Services organization responsible for installing and maintaining hardware and software products through a portfolio of service offerings.

Field Service Logistics (FSL)

The organization responsible for material processing within Field Services; has responsibility for materials, repairs, and distribution of hardware parts to the Field Service personnel.

Field Services Pricing and Policies Committee (FSPPC)

Committee responsible for service pricing and policies relating to the Field Service organization.

Finance

Finance has the a key responsibility for providing financial support to the Product Team in the preparation of Business Plans and other product planning activity. The Product Business Unit (PBU) or sponsoring organization Finance Manager is responsible for coordinating finance activities across all Product Team functions.

First Revenue Ship (FRS)

Date that signifies the first product shipment to a paying customer external to Digital. This does not include field test units, seed units, or any other Corporately approved conditions under which a product may be given to a customer.

Functional Software Product/Hardware Pilot

Product built to specification with a volume level process and qualified parts.

Functional Specification

A document that tells *what* a product must do from the user perspective. Must include performance requirements for each functionality. It should include visual elements, for example Data Flow Diagrams to prevent ambiguity.

Geography Planning Groups

Field Service individuals responsible for the introduction, planning of new, and retirement planning of old products within their specific geographies.

Hardware Pilot/Functional Software Product

Product built to specification with a volume level process and qualified parts.

Hardware Product Services (HPS)

Field Service group responsible for business decisions relating to hardware portfolio of services.

Hardware Prototype/Software Functional Code Freeze

Complete working version of the product built to specification. Product has not been tested to meet standards, regulations, or manufacturing criteria.

Header Contact

A header organization is an order fulfillment organization with a goal to improve customer order fulfillment accuracy and timing.

Presently the U.S. and GIA order fulfillment responsibility resides in the U.S. Area Mfg. group, presently called the U.S. Business Center.

H Kits

Media and full documentation on a software product.

International Engineering Development (IED)

IED – International Engineering Development (Focal point is Jim Mills. See ELF for contact information.)

Internationalization Plan

Forms the commitment by IED to provide the Product Team with consulting services, development and delivery of product variants, and coordination of localization work at area and country levels for Europe and GIA. The plan identifies those dependencies that IED and the countries have on the Product Team to meet these commitments and provides the method for measuring progress of the internationalization effort.

KPL

Computerized Parts List

Law Department

Department within Digital that offers legal services to the various functions, for example, the Engineering Law section has the key responsibility for providing legal support to the Product Team.

Maintenance Service Expense (MSE)

A term used by Field Service to denote their maintenance expenses in providing service for their products.

Marketing Advisory Board (MAB)

A committee of representatives of all marketing organizations; PMGs, Industries, Services, PBU, Channels, CSSE. MAB proposes announcement messages, recommends product positioning for 8–quarter volume planning, approves application characterization plans, and advises the VP of Product Marketing on Corporate product strategy issues.

Marketing and Sales Strategy Committee (MSSC)

The Marketing, Sales, and Strategy Committee (MSSC) ensures that industry marketing strategy, channel strategy, and geographic plans are integrated with the systems and applications strategies. MSSC provides a forum for discussion/resolution of key product positioning strategies and is responsible for:

- Approving product pricing strategy, working closely with PMSC and Executive committee as required.
- Approving announcement strategy for all products

- Approving promotion strategies for all products
- Approving and reviewing the implementation of major marketing and geographic sales programs.

Proposals with strategic importance require both PAC and MSSC approval. PAC proposals with revenue more than $25 million in the next 12 months, with major waivers, or of strategic importance must have MSSC approval.

Market Performance Review

Digital Specific:

Term used in the Phase Review Policy. A Market Performance Review is conducted within 12 months of the product release to the field. The review is then held periodically (usually every quarter) to evaluate the performance of the product in the field. The results of the reviews are used as part of the decision to continue with, enhance or phase–out the product.

Maynard List Price (MLP)

Price from which the country list prices, including the United States, are derived.

Mean Time Between Calls (MTBC)

The average time between corrective maintenance calls.

Mean Time Between Failures (MTBF)

The average time between failures.

Mean Time to Install (MTTI)

The average time to install an option or system. This time includes administrative, travel, and labor.

Mean Time Between Parts Replacement (MTBPR)

The average time between calls which require parts consumption. Mean Time Between Parts Replacement (MTBPR) is a term used by Field Service Logistics for planning spares inventory.

Mean Time to (accomplish) Repair (MTTR)

The average time required to complete a corrective service call. This includes administrative, travel, and labor time.

Mission Critical Applications

Applications which are essential to the operation of an enterprise, as distinguished from supporting applications such as payroll. Mission critical applications are different for each industry.

New Products Form (NPF)

An Software Distribution Center (SDC) form that must be completed before a software product can be duplicated and distributed.

New Product Start–Up (NPSU)

The costs in manufacturing for tooling, test equipment, and so on.

Ongoing Reliability Testing (ORT)

Ongoing Reliability Testing done in manufacturing plants on regular production units to check that the reliability is being maintained.

Original Equipment Manufacturer (OEM)

An OEM is an organization that purchases computer components from various manufacturers, assembles them to create a single unit, supplies it with additional hardware and/or software developed for specific applications, and sells it as a package.

Digital sells to end users both directly and through OEMs. OEMs in this context are an extension of the Digital Sales force.

PARC

Acronym for Pricing and Announcement Readiness Committee. PARC is the European equivalent to PAC.

Phase Exit Transition

A formal checkpoint event (or set of events). At this time, the Product Team verifies and agrees that appropriate phase Exit Criteria have been met. Primary participants are the Product Team members. Product Management will obtain appropriate level of approval. When Phase Exit is achieved, it is announced to the appropriate parties.

Plan of Record

Phase 1 business plans are the basis for the "go/no go" investment decisions and provide details sufficient to judge the quality of the investment. These plans are also called the "Plan of Record" by which the Corporation measures the quality and success of the investment decisions.

Product Phase-Down

Term used to indicate withdrawal of a product from the Sales arena. When a product is "phased-down," Digital devolves its marketing, manufacturing and sales responsibilities. Normally, service continues for some period of time.

Phase Review Committee (PRC)

The Phase Review Committee is a cross-functional body that meets monthly to review product status, identify issues, recommend further action, and approve the phase exit transitions for all Top 100 products.

Pilot/Functional Software Product

Product built to specification with a volume-level process and qualified parts.

Planning Automated Support System (PASS)

Customer Services new product planning database containing information and plans on all new and retired products.

Post Project Review

A review meeting held at the end of Phase 4A to review the performance of the Product Team in Phasing-in the Product.

Press Consultants and Analysts (PCA)

A subcommittee of ASC; recommends press, consultant, and analysts event plans to ASC. Manages the implementation of approved plans.

Pricing and Announcement Committee (PAC)

The Digital Corporate body that approves announcements and First Revenue Ship (FRS) of Products.

PAC is composed of representatives from all major groups in the Corporation including: Marketing, Product Management, Engineering, Manufacturing, Sales, Legal, Finance, Services and Administration. PAC establishes and publishes criteria for Product readiness, Sales readiness and Support readiness.

Proposals with strategic importance require both PAC and MSSC approval. PAC proposals with revenue more than $25 million in the next 12 months or with major waivers must have MSSC approval.

PAC meets as a subcommittee of the Marketing/Sales Strategy Committee (MSSC) to verify that announcement and readiness criteria is met and to approve product pricing. Once this is done, the product is announced and is then transitioned into production, sales, and service. PAC First Revenue Ship (FRS) criteria must be completed prior to FRS.

Problem Resolution and Information Systems Management (PRISM)

A Field Service database containing noncritically known hardware problems and finally their solutions.

Product Business Unit (PBU)

The PBU is a business unit within Digital responsible for a portfolio of products. PBUs are divided into two types: systems PBUs and component PBUs. The PBUs plan and measure the worldwide success of the Corporation from the business/product perspective rather than from the functional performance perspective.

Product Captain

Provides a worldwide Sales perspective of the product to the PBU or other sponsoring organizations. Coordinates product plans between the Field, Engineering, Manufacturing, Marketing and Services.

Responsibilities include:

- Drive the Field Product Strategy Process
- Manage Field Volume Planning Process
- Initiate and Support Product Introduction Programs
- Manage Product Business Problem Resolution

Product Marketing Strategy Committee (PMSC)

Reviews product strategy from Marketing and Engineering standpoint; involves sharing information and setting directions.

Product Requirements Document

Document that defines the technical requirements and required functionality of a product. The Product Requirements document contains the base information from which the functional specification will be prepared as well as the schedule and cost estimates required for Phase 1 closure.

Product Team

This team is headed by the Product Manager. The Product Team generally has membership from the following functions; Product Management, Engineering, Marketing, Manufacturing, Customer Services, and Sales. Team size and composition is directly related to the product type and complexity. Team members coordinate all the tasks and integration activities across their respective functions to ensure successful delivery and service of the total product.

The Product Team supports the development of international products and their product variants. Information is gathered concerning worldwide market need and requirements. The resulting systems, products, and services are introduced into the marketplace. Resources available across the Geographies support the Product Team as the product moves through the phases.

Proprietary Information Disclosure (PID)

In certain situations it is necessary to disclose information on unannounced products and programs to customers to facilitate their long range planning in the interest of Digital's long term relationship with them. It is the goal of the Proprietary Information Disclosure Policy that these disclosures be consistently employed across the company.

Types of Proprietary Information Disclosures:

- Corporate Strategies – broad in scope in order to provide proper content for decision making.
- Major Upcoming Announcements – intent is to provide our major customers with advance notice of an upcoming strategic announcement.
- Future Products/Programs – not requiring strong control, minimal risk to revenue stream.
- Field Test and Independent Software Vendor Presentations – created to meet the needs to qualify field test sites and to provide information required by software vendors.

Prototype/Software Functional Code Freeze

Complete working version of the product built to specification. Product has not been tested to meet standards, regulations, or Manufacturing criteria.

Qualification Testing

Qualification Testing includes:

- Regulatory testing and approvals
- Other Digital standard testing or appropriate external testing
- Performance testing
- Testing in all supported environments
- Reliability Qualification Testing
- Software certification and evaluation by applicable software quality test groups (for example SQM/SQG)
- Internal Field Test
- External Field Test
- Process Verification Test (PVT) and Process Qualification Test (PQT)
- Application Characterization
- Design Maturity Test

Ramp–Up

The process of getting from initial production, sales, and services to steady state production, sales, and services.

Regression Testing

Regression testing is an activity performed on a new product baselevel and involves putting the product through a minimum, rigorous set of test procedures to ensure that all expected functionality of the product is present and working correctly. Regression testing provides confirmation that no regression of capabilities of the current baselevel has occurred as a result of either modifying it to correct problems or adding new functionality.

Reliability, Availability, Maintainability Program (RAMP)

The collection of goals, strategies, and requirements that are specified to ensure product success and profitability in the marketplace from a service viewpoint.

Reliability Qualification Testing (RQT)

Testing to demonstrate that the intended reliability level has been achieved.

RSL/ARL

Recommended Spares List/Authorized Returns List – lists maintained by Field Service Logistics for parts handling.

Serviceability/Maintainability Test Plan

Services plan to test the product from a Services viewpoint.

Services Impact and Requirements Document

Phase 0 deliverable from the Services representative on the Product Team. It includes the anticipated impact on Services of the proposed product and also the service requirements that should be considered in developing this product.

Services Market Appraisal

Document that describes the changing product environment and the impact of that environment on services. It also details specific marketing strategies and programs that will best allow management of the services business.

Services New Product Notifier

Notification of a new product from Services Program Team member to other Service functions.

Software Functional Code Freeze/Hardware Prototype

Complete working version of the product built to specification. Product has not been tested to meet standards, regulations, or manufacturing criteria.

Software Problem Reports/Quarter (SPR/QTR)

Software problems reported per quarter.

Software Product Description (SPD)

The document which is the legal definition of the product functionality. It describes software, minimum hardware needed to support it, components and services.

Software Product Services (SPS)

Field Service group responsible for business decisions relating to software portfolio of services.

Sponsoring Organization

This organization champions and funds, internally or externally, product development and delivery.

Sustaining Engineering

Also called Support Engineering, Maintenance Engineering

The engineering function that is responsible for supporting Digital products during Phases 4 and 5.

Technical Information Management Exchange (TIME)

Technical Information Management Exchange is a software problem reporting system (database) used by Field Service.

Top 100 Process

Top 100 Process – Products with the following criteria are selected for inclusion on the Top 100 list:

- All major systems
- High–revenue–producing components
- Major software products
- High–strategic–impact products of any nature

Most new projects are entered on the list during Phase 0 or Pre–Phase 0. These projects remain on the list until First Revenue Ship (FRS) or until they are canceled. Products on the Top 100 list have not completed the phase review exit process until they are approved by the Phase Review Committee.

Verification Test Plan

The collective activities and events that provide an organized plan to ensure that the quality of a product will satisfy the requirements as defined in the Product Requirements Document. The Verification Test Plan identifies the purpose, procedure, data and expected results of the test.

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You comments and suggestions will help Standards and Methods Control improve their services and documents.

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DEC STD 130-0 PRODUCT/SYSTEM BUSINESS PLANS: CONTENT REQUIREMENTS AND FORMAT GUIDELINES

DOCUMENT IDENTIFIER: A-DS-EL00130-00-0 Rev C, 17-May-1985

ABSTRACT: Business plans shall be written for all new products or systems except when deemed unnecessary by the Product Engineering Group (PEG). This standard describes content requirements for a business plan. It applies to all new products and systems being considered for development. It outlines requirements for the following parts of the plan: Executive Summary, System/Product Description, Life Cycle Forecast, Assumptions, Risks, and Financial Analysis.

APPLICABILITY: Mandatory for all new products and systems being considered for development.

STATUS: APPROVED 17-May-1985; see EL-INDEX-00 for expiration date.

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TITLE: DEC STD 130-0 PRODUCT/SYSTEM BUSINESS PLANS: CONTENT REQUIREMENTS AND FORMAT GUIDELINES

DOCUMENT IDENTIFIER: A-DS-EL00130-00-00 Rev C, 17-May-1985

REVISION HISTORY:

Rev A, 23-Jul-1977	ECO # ML002
Rev B, 03-Dec-1981	ECO # AP003
Rev C, 17-May-1985	ECO # AP003

Document Management Group: Product Management Process Requirements (TPR)

Responsible Department: Engineering Financial Planning and Analysis

Responsible Individual: Terry Fink

APPROVAL: This document has been updated to incorporate clerical changes. No changes have been made in the technical content from the previous revision. This document has been acknowledged to be current and applicable by the responsible person and Standards and Methods Control.

Joseph M Kurta

Joseph Kurta, Manager - Standards and Methods Control

Direct requests for further information to:

Terry Fink
ML012-2/A16, DTN: 223-2197, DEVEL::FINK

Copies of this document can be ordered from:

Standards and Methods Control,
APO-1/F7, DTN: 289-1414, JOKUR::SIMONETTI

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1 INTRODUCTION

The business plan is a comprehensive set of business metrics designed to evaluate the potential of a new product in a format that permits comparison to other products. It is used by Senior Digital Management to review the product's strategy, business viability, and required investment.

1.1 PURPOSE

The purpose of this standard is to describe minimum content requirements, and format guidelines, for a system or product business plan. The business plan is part of the Phase Management Process, the primary tool in ma[naging a product over its life cycle.

1.2 SCOPE

This standard applies to new systems and products requiring a business plan as determined by the Product Engineering Group (PEG). It describes what a business plan shall contain by outlining requirements for the Executive Summary, System Description, Shipment Forecast, Assumptions, Risks, and Financial Analysis. Also, it suggests a sample format.

This standard presents minimum requirements; it is not intended to be all inclusive. Additional information necessary to understand a product should be added. Phase 0 plans, by definition, will contain preliminary target estimates and are not expected to reflect the precision of the plan in later phases.

All projects with an Engineering investment greater than $500K require a Life Cycle Financial Analysis (Business Review Plan [BURP]).

All projects expecting revenue in excess of $1/2 billion, or having a total investment greater than $10 million, require a Business Plan Review by the Group Vice Presidents' Committee (GVPC) at Phases 0 and 2A, and one to two years after First Revenue Ship (FRS).

While no business plan standard has been defined for software products, a software business plan shall follow the outline defined herein, modified as appropriate (see also Software Development Policies and Procedures, section 5D1-1.B, Software Product Business Plan). Software business plans are required for major products, but not for versions or updates of major products.

1.3 RESPONSIBILITIES

1.3.1 Product Engineering Group (PEG)

PEG is responsible for the business planning policy and structure established by this standard. Any questions or comments relating to the standard may be directed to the Engineering Finance Manager for Product Financial Analysis (ML012-2/A16, DTN 223-1932), or the Manager of the Corporate Product Management Staff (ML012-1/T39, DTN 223-3123).

1.3.2 Product or Project Managers

The Product or Project Manager is responsible for the preparation and maintenance of business plans according to the requirements of this standard.

1.3.3 Standards and Methods Control

Standards and Methods Control is responsible for the administration and distribution of this standard. Additional copies are available from Standards and Methods Control, APO-1/F7, DTN: 289-1414.

1.4 REFERENCED STANDARDS AND DOCUMENTS

1.4.1 Documents

If the following documents are not available from local Program Offices, copies may be obtained from departments in parentheses.

- Digital System Price Band Charts
  (Engineering Finance, ML012-2/A16, DTN 223-1932, or Central Engineering Product Management Staff, ML012-1/T39, DTN 223-3123)

- Corporate Revenues, Budgets, Long-Range Plans, & Forecasts
  (Engineering Finance, ML012-2/A16, DTN 223-1932)

- BURP (Business Review Program) Manual
  (Engineering Finance, Product Investment Analysis, ML012-2/A16, DTN 223-0334)

- Quarterly Economic Forecast
  (Office of the Corporate Economist, ML010-1/F41, DTN 223-2365)

- o Red Book/Engineering Strategy Overview
  (Central Engineering Product Management, ML012-1/T39, DTN 223-3123)

- o Software Development Policies and Procedures
  (Software Architecture and Tools, ZK01-3/J10, DTN: 264-8321)

1.4.2 Standards

EL-00028-00	DEC STD 028-0 Phase Review Policy
EL-00060-00	DEC STD 060-0 Design and Certification of Hardware Products to National and International Regulations and Standards - Policies And Procedures
EL-00062-00	DEC STD 062-0 Product Submittal to U.S. and Non-U.S. Agencies

Standards may be obtained from Standards and Methods Control, APO-1/F7, DTN: 289-1414.

2 GENERAL STATEMENTS ABOUT BUSINESS PLANS

A business plan is much more than a technical description of a product. It should be approached as if it were a "sales" document directed at a venture capital firm or a group of potential investors.

The plan is a description of the realistic implementation of the life-cycle of the product. It includes not only the product's technical characteristics, but also the marketing, manufacturing, service, and financial implementation necessary to be commercially successful. The plan must show how the product supports and enhances Digital's engineering, marketing, and financial strategies. The plan must delineate the potential risks. It must clarify any "make/buy" decisions.

Generally, the Phase 0 goals of the product will optimize on maximizing the present value of life-cycle profit. Maximization of the present value of the project's cash flow results in the highest possible economic worth to Digital. Occasionally, projects will have compelling reasons not to optimize on value (e.g., time-to-market for first product of an evolving family). These reasons must be clearly explained. A Phase 0 Business Review Plan (BURP), a financial model of the product's life-cycle, is required based on preliminary or target estimates.

A business plan of a major product shall be reviewed by the GVPC (Group Vice President's Committee) at three points in its life cycle:

a. Phase 0 exit

b. Mid-way through Phase 2 (prior to Manufacturing RAMP-Up)

c. One to two years following FRS (First Revenue Ship).

The first two reviews by the GVPC are formal "go/no go" decisions to continue the project. An updated BURP shall be an integral part of each of these reviews.

Major projects are defined as those expected to produce greater than $1/2 billion NOR (Net Operating Revenue), or incur development and Manufacturing RAMP-Up expense in excess of $10 million.

Business plans of products not meeting these thresholds shall be inspected by the relevant PEG member (and staff), and by other corporate review forums as GVPC feels appropriate.

Business plans become official when released for publication by the relevant PEG member and Finance Manager.

SAMPLE BUSINESS PLAN

____________________ BUSINESS PLAN
(name of product/system)

At Exit from Phase____

Prepared By: __________________________________

Revision Number: __________

Date: ____________________

Note

For examples of a completed System/ Product Business Plan, contact your local program office, Engineering Finance Product Investment Analysis (ML12-2/A16, DTN: 223-8027), or Central Engineering Product Management Staff (ML12-1/T39, DTN: 223-3123).

Approved for Publication: ______________________
(PEG Member)

____
(Group Financial Mgr.)

SYSTEMS PROJECT TEAM

Team Leader, Product or Project Manager ________________________

Engineering:

Engineering Project Mgr ________________________

Program Manager ________________________

Engineering Manager ________________________

Project Engineer ________________________

Diagnostics/Field Test ________________________

Financial Manager ________________________

Manufacturing:

Manufacturing Project Mgr ________________________

Volume Manufacturing ________________________

FA&T ________________________

New Product Start-Up ________________________

Customer Services:

Customer Services Project Mgr ________________________

Field Service ________________________

Software Services ________________________

Educational Services ________________________

Product Groups:

(Identify if included on the project team)

____

____

____

1 EXECUTIVE SUMMARY

The Executive Summary is a brief statement (no more that four pages) of the critical elements of the plan directed at high-level managers who may or may not have time to review the entire plan.

The summary should enable the reader to assess quickly the viability of the plan, the product's chance for commercial success, and its probability for successful implementation by Engineering, Manufacturing, Customer Services, Marketing, and Sales. In addition, the reader should obtain a feeling for the importance of the product to Digital's strategy based on the size of expected investment, revenues, and net present value.

1.1 EXECUTIVE SUMMARY: SYSTEM DEFINITION

Briefly define the system or product. Omit lengthy descriptions of features.

1.2 EXECUTIVE SUMMARY: GOALS FOR THE SYSTEM

Goals described below are the jointly agreed upon objectives of the Engineering, Manufacturing, and Customer Services Project Team (unless otherwise explicitly stated). If maximizing the net present value of cash flow is not the primary goal, please say so.

1.2.1 Marketing Goals

Identify the top five or so goals that define the product's success factors in the marketplace (for example, time-to-market, price/performance, site mergeable, high-availability, cosmetic, market share, etc.).

1.2.2 Engineering Goals

Identify the critical development goals/features required to achieve marketing goals.

1.2.3 Manufacturing Goals

Describe make vs. buy strategy, cost minimization goals, site mergeable goals, etc.

1.2.4 Service Goals

Describe reliability, maintainability, basic monthly charge (BMC), and service cost reduction goals.

1.2.5 Financial Goals

Describe NPV, IRR, ROA, PBT, and payback goals.

NPV = Net Present Value of project's cash flow (discounted at Engineering Hurdle Rate of 40%)

IRR = Internal Rate of Return

ROA = Return on Assets employed

PBT = Profit Before Tax

1.3 EXECUTIVE SUMMARY: RELATIONSHIP TO CORPORATE PRODUCT STRATEGY

Describe how the system's goals enhance the Corporate Product Strategy. (Refer to the Engineering Strategy Overview for current Corporate Product Strategy.)

1.4 EXECUTIVE SUMMARY: NUMERICAL HIGHLIGHTS

In tabular format, highlight the financial summary, schedule, configurations, and critical dependencies. Data source is the standard BURP Financial Model.

Lifetime Base Data		Schedule: Q/FY		Financial Metrics
# Units Shipped		Announcement	______	#Qtrs to Payback from FRS _____ Qtrs
Lifetime NOR	$ M	Product Available	______	
Gross Margin %NOR	%	FRS	______	Development Cost % NOR ______ %
PBT % NOR	%	Cash Payback	______	
		Last Ship	______	NPV @ 40% $ ______
				IRR % ______ %

Configuration

	Entry System	Typical System	Maximum
Maynard List Price	$	$	$
Transfer Cost	$	$	$
Memory (MB)	(name) ______ MB	(name) ______ MB	(name) _____ MB
Disk(e.g.RM80 - 124MB)	(name)	(name)	(name)
Tape (e.g., TS11)	(name)	(name)	(name)
Performance(11/780 =1.0)	XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX	(.6)	XXXXXXXXXXXXX XXXXXXXXXXXXX

Critical Dependencies

Identify other products, or other events, essential to meet the goals of this product.

1.5 EXECUTIVE SUMMARY: MARKETING STRATEGY SUMMARY

1.5.1 Market Size

Summarize a description of target market, size, growth, market share, and competitors' positions.

	FISCAL YEAR						
	N-1	N	N+1	N+2	N+3	N+4	etc.
Total Market($)							
Share:							
DEC							
Competitor A							
Competitor B							
Others							

1.5.2 Applications (Market Segmentation)

Summarize targeted applications areas and, if possible, rank by lifetime NOR (Net Operating Revenue). For each application area:

a. Indicate the approximate percentage of total projected system NOR and Marketing Groups distributing the product to this segment.

b. Describe the product's marketing message to each segment.

Application/Segment Description	Marketing Message	$ Lifetime System NOR	Channels (Marketing Groups)

Total =

1.5.3 Geographic Distribution (U.S., Europe, GIA)

Summarize the international distribution plans by approximate percentages. If the product will not be offered in a major country, give reasons. Highlight any major international regulatory, safety, or environmental requirements affecting the business plan. Also, describe any product variants for sale in different countries (for example, local language versions).

1.6 EXECUTIVE SUMMARY: PHASE PLANNER

Indicate the expected dates (quarters and fiscal years) of phase transitions as described in the Phase Planner.

Phase	Date of Exit from Phase (Q/FY)
0 (Strategy & Requirements)	______________
1 (Planning)	______________
2 (Implementation)	______________
3 (Qualification)	______________
4 (Production & Support)	______________
5 (Retirement)	______________

1.7 EXECUTIVE SUMMARY: RISK ASSESSMENT

Place an "X" over one number on each line to approximate the level of risk involved for each of the following variables.

		Low Risk		High Risk
			1 2 3 4 5 6 7 8 9 10	
TECHNOLOGY				
	For Industry	well established, know how to do	1 2 3 4 5 6 7 8 9 10	never done before
	For Digital	well established, know how to do	1 2 3 4 5 6 7 8 9 10	never done before
MANUFACTURING				
	Test Procedures	well established	1 2 3 4 5 6 7 8 9 10	new techniques
	Processes	well established	1 2 3 4 5 6 7 8 9 10	new
SERVICE		similar to many products, high ease of diagnosis	1 2 3 4 5 6 7 8 9 10	new techniques new service procedures, much training, sparing
MARKETING				
	Distribution Channels	traditional end-user direct sales, or OEM/reseller; standard terms and conditions	1 2 3 4 5 6 7 8 9 10	new distribution channels, new terms and conditions,new order processing procedures
	Customer Base	current Digital customers	1 2 3 4 5 6 7 8 9 10	new Digital customers
	Customer Capability	highly technical	1 2 3 4 5 6 7 8 9 10	computer naive
	Applications	well understood, done before	1 2 3 4 5 6 7 8 9 10	new applications

2 BUSINESS PLAN: SYSTEM/PRODUCT DESCRIPTION

2.1 SYSTEM/PRODUCT LIFE CYCLE OVERVIEW

Describe the sequence of products to be offered over the system's life cycle. Identify those Digital products affected by the introduction and phase-in of the new products. Also, identify when this system will be phased over to succeeding products. A graphic presentation would be useful.

2.2 KEY FEATURES - INITIAL SYSTEM/PRODUCT OFFERING(S)

Describe major features within the following categories. Relate these features to the customer's benefit.

2.2.1 Marketable Features - Relating To Customer Utility

a. System/product hardware and packaging

b. System/product software

c. Services

d. Availability, reliability, ease of diagnosis and repair

e. Price

f. Features to minimize customer cost of ownership

g. International features (e.g., non-English language, plug into non-U.S. power)

2.2.2 Features to Reduce Life Cycle Cost to Digital

Describe features that help maximize corporate return on investment, particularly in the areas of:

a. Transfer cost (complexity, number of configurations, features that contribute to volume manufacturability, etc.)

b. Final assembly and test (e.g., dock merge, customer installable)

c. Installation quality and cost (relates directly to size of accounts receivable, days sales outstanding)

d. Warranty and service costs (for example, remote diagnosis, mean-time-to-repair, etc.)

e. Inventory (components common to other products, short manufacturing path, and other factors that can help minimize inventory requirements)

2.3 FUTURE SYSTEM/FOLLOW-ON PRODUCT OFFERINGS

Describe planned changes or additions to features ("mid-life kickers"), changes in pricing structure, or other plans to sustain marketability over its life cycle.

2.4 SYSTEM/PRODUCT POSITIONING

Describe, or show graphically, how the system or product will be positioned against:

2.4.1 Digital Products

a. Relationship to existing and future products.

b. How Phase-In and Phase-Out will occur.

c. Family attributes and protection of installed base.

2.4.2 Competitive Products

a. Market size, Digital's share, this product's share

b. Competing products, present and expected, over the system's life cycle.

c. For each major competitor identify relative system strengths and weaknesses.

2.4.3 Price Positioning Charts

a. System Price Band Charts against Digital and Competitive Systems

b. System NES as a Percentage of Corporate NES

2.4.3.1 System/Product Price Bands - For the standard price bands show:

a. Price positioning against existing and future Digital products.

b. Price positioning against existing and future major competitive products.

2.4.3.2 System/Product NES (Net Equipment Sales) as a Percentage of Corporate NES

a. NES as a percentage of total corporate NES

2.5 TECHNOLOGY

Briefly describe:

a. Technology advancements critical to system development.

b. System/Product position relative to state-of-the-art.

c. Likely replacement technologies and when they are expected to affect the system or product.

3 SHIPMENT FORECAST

3.1 SYSTEM/PRODUCT WORLDWIDE FORECAST

"Internal to Digital" shipments are shown separately from shipments to the external marketplace. Clearly indicate the source of the forecasts (note that in Phase 0 there may be no Market Group commitment to ship volumes).

Obtain total corporate forecasts for Transfer Cost, NES, and NOR from the contacts listed in subhead 1.4., Referenced Documents and Standards.

(System Name)	FY___	FY___	FY___	FY___	FY___	Life Total
Unit Shipments:						
External						
Internal to DEC (IEG)						
TOTAL						

System Net Revenues:						
System	$	$	$	$	$	$
Add-ons	$	$	$	$	$	$
Layered Software	$	$	$	$	$	$
TOTAL SYSTEMS NES	$	$	$	$	$	$
% Corporate NES	%	%	%	%	%	%
System Service Revenues						
System NOR						
% Corporate NOR	%	%	%	%	%	%

% Unit Distribution by Operating System:						
% None						
% RT-11						
% RSTS/E						
% RSX-11M						
% VMS						
% Tops 10/20						
% Other (specify)						
% Non-DEC						
TOTAL	100%	100%	100%	100%	100%	100%

3.2 DETAILED WORLDWIDE UNIT SHIP FORECAST BY MARKET GROUP

Forecast worldwide system/product shipments by Marketing Group, showing "Internal to Digital" shipments as well, and by international area.

Marketing Group	Worldwide Unit Forecast by FY N	N+1	N+2	N+3	N+4	Life Total
Internal to DEC (IEG)						
Technical:						
Commercial:						
Tech. Volume:						
Computer Products:						
TOTAL EXTERNAL:						
Geographic Mix % Shipments to:						
U.S.						
Europe						
GIA	100%	100%	100%	100%	100%	100%

3.3 IMPACTED PRODUCTS: PHASEOVER FORECAST SUMMARY

For products this system will impact or replace, provide at least a three year history and forecast for the remaining planned life. Describe the impact of not bringing the product to market.

Impacted Product #1	Actual N-3	N-2	N-1	Forecast N FRS	N+1	N+2	N+3	N+4
Unit Shipments #								
NES	$	$	$	$	$	$	$	$
Service Revenues	$	$	$	$	$	$	$	$
NOR	$	$	$	$	$	$	$	$

Impacted Product #2	Actual N-3	N-2	N-1	Forecast N FRS	N+1	N+2	N+3	N+4
Unit Shipments #								
NES	$	$	$	$	$	$	$	$
Service Revenues	$	$	$	$	$	$	$	$
NOR	$	$	$	$	$	$	$	$

3.4 INCREMENTAL IMPACT OVER SYSTEM/PRODUCT LIFE (OPTIONAL)

Summarize the expected incremental value (the added value associated with doing this system compared with not doing it) in the left-hand column and the impact (increase or decrease) on other systems or products in adjacent columns.

FY____ to FY____ Product:	INCR. VALUE	INCREMENTAL IMPACT ON OTHER PRODUCTS (NAME)	(NAME)	(NAME)
Unit Shipments: External Internal to DEC				
NES Service Revenue NOR				
Gross Margin Profit before Tax Profit after Tax				
Net Present Value @ ____ %				

4 ASSUMPTIONS

List key assumptions crucial to the system's or product's success. The objective is to identify and weigh the impact of each assumption.

Each assumption should identify the responsible person, organization, and referenced document where additional detail may be found. Reference all documents in subhead 6.

Within each category, begin with the assumption that represents the greatest risk, working down to the assumption that represents the least risk. Some redundancy of information presented earlier will be necessary to record all crucial assumptions in one place.

4.1 ASSUMPTIONS: ENVIRONMENT

4.1.1 Competition

Identify assumptions of market size, Digital's share, competitors' share, competitive positioning, strengths, and likely counter moves.

4.1.2 Geography

Identify any major area (country) markets where the system/product will not be offered.

4.1.3 Regulatory Compliance

List all key regulatory requirements or industry standards that are not planned to be met. See DEC STD 060, Design and Certification of Hardware Products to National and International Regulations and Standards. Further information on all of these requirements can be obtained from Hardware Design Assurance, ML11-3/H19, DTN: 223-9837.

For further European requirements, contact the European regulatory liason, ML12-2/E71, DTN 223-3061.

4.1.4 Economic Factors

Relate sensitivity of revenue forecasts and projections (i.e., transfer cost to NOR) to:

a. Fluctuations in U.S. and international economies, rates of inflation, Gross National Product, or other indicators

b. Price and performance trends in Digital's markets

c. Price elasticity of demand

4.1.5 Operating Environment

Range of operating conditions over which the system will perform effectively. For example, Class A or Class B environment (see DEC STD 062, Product Submittal to U.S. and Foreign Regulatory Agencies and other related standards).

4.2 ASSUMPTIONS: TECHNOLOGY

4.2.1 New Processes And Components

List assumptions concerning key technologies new to Digital or to the industry.

4.2.2 Design Tools

List new tools Digital must develop or acquire.

4.2.3 Key Suppliers of Components

List assumptions about suppliers and the availability of key system components.

4.3 ASSUMPTIONS: INTERNAL FUNCTIONS

Assumptions should highlight system requirements that cross functional and organizational lines. The following explanations of each category are intended to serve as examples of the kinds of assumptions to consider.

4.3.1 Engineering Dependencies

a. Operating system support (for example, system must be supported by VMS V.3)
b. Peripherals supported
c. Interconnect
d. Power and packaging

4.3.2 High-Volume Manufacturing Dependencies

a. Test equipment availability
b. Diagnostic approach
c. RAMP plans; Phase-in/Phase-out
d. New manufacturing technologies (for example, fine line etch, multilayer backplane, etched backplane, etc.)

4.3.3 Final Assembly and Test Dependencies

a. Dock mergeable systems (or site or field mergeable) - number of configurations, when they will be implemented
b. Packaged systems - number of configurations

4.3.4 Customer Services Dependencies

a. Installation time for hardware and software
b. Self-installable hardware and software
c. System acceptance procedure (e.g., VAX System Functional Test [EVXBB], DEC/X11, User Environmental Test Package [UETP], etc.)
d. Warranty type and period
e. Mean-time-to-repair (MTTR) goal
f. Mean-time-between-failures (MTBF) goal
g. Hardware and software Basic Monthly Charge (BMC) goal
h. Training
j. Sparing

4.3.5 Marketing

List priorities for development (time-to-market, cost and performance, family and compatibility, etc.), advertising, and promotion.

4.3.6 Sales

List distribution channels and unusual training requirements.

4.3.7 Asset Management

List goals for:

a. Weeks of Inventory
b. Days Sales Outstanding

4.4 ASSUMPTIONS: CUSTOMERS

4.4.1 Impact on Key Accounts

List how the system will meet the needs of key Digital customers in the targeted market segments.

4.4.2 New Opportunities

List which new customers the system will attract. Also identify those existing customers that will be attracted by the system's new applications.

Refer to the Market Data Center Customer Data Base, PK3-1/S52, DTN: 223-3632, for information.

4.5 ASSUMPTIONS: SCHEDULE

Attach Phase Planner, which includes list of major milestones and dates.

Refer to DEC STD 028, Phase Review Policy.

5 FINANCIAL/SENSITIVITY ANALYSIS

5.1 FINANCIAL: SUMMARY AND CONCLUSIONS

Summarize the key business and financial issues (risks, sensitivities) which will have the greatest impact on the financial viability of the product. Data is from the Standard Product Financial Model (BURP).

5.2 FINANCIAL BASE CASE ANALYSIS - NUMERICAL SUMMARY

FY ____ TO FY ____

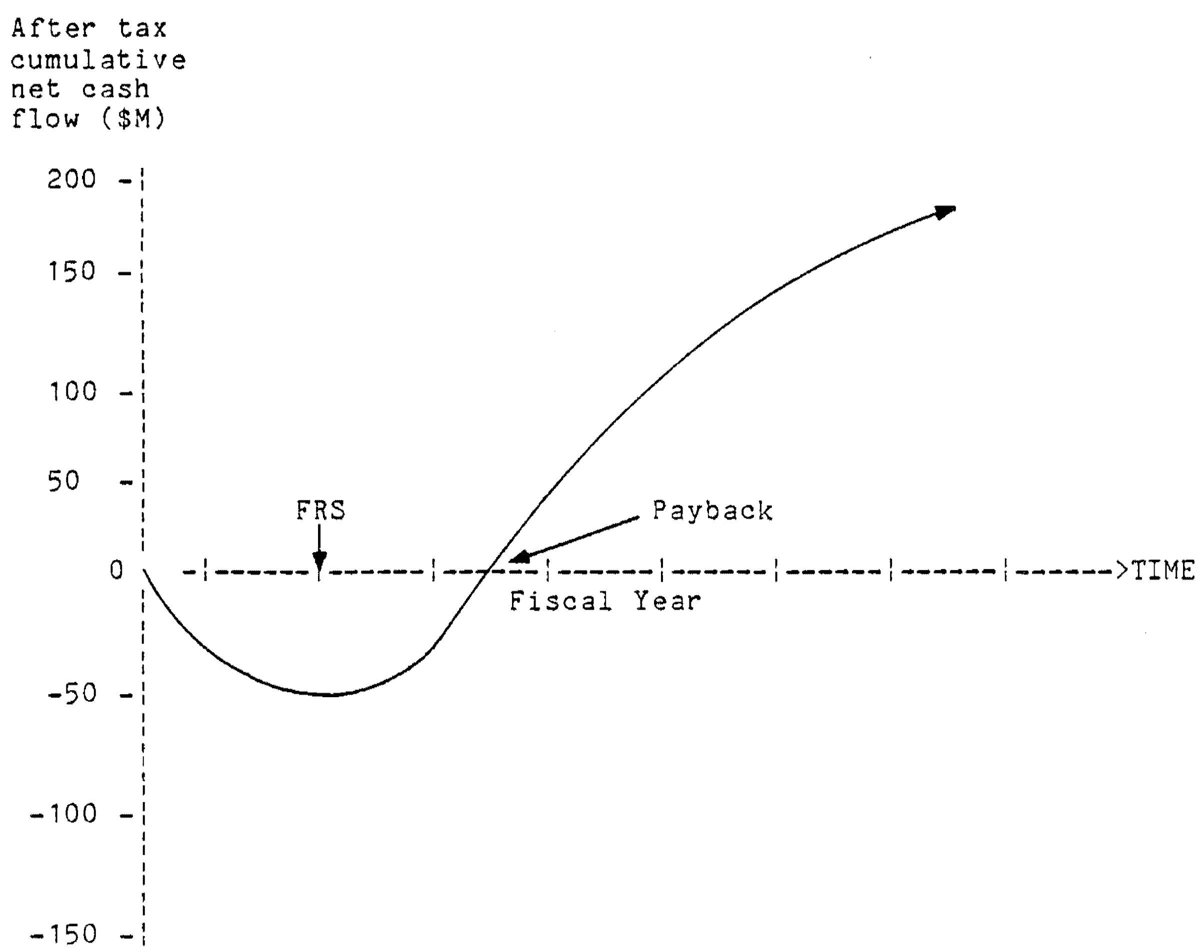
Total Lifetime Revenue	$ ________	
Less: Cost of NOR	$ ________	
Gross Margin	$ ________	(____% NOR)
Development Expense	$ ________	(____% NOR)
Selling, Marketing, G&A Expense	$ ________	
Pre-Tax Profit	$ ________	(____% NOR)
After Tax Net Cash Flow	$ ________	
After Tax NPV @ 40% hurdle rate	$ ________	
Internal Rate of Return	________ %	
Payback Date	________	(No. of Quarters to Payback from FRS ____)
Max. Negative Cash Flow (Cumulative after tax)	<$ ________>	

5.3 FINANCIAL MODEL ASSUMPTIONS

Describe assumptions for each major item on the BURP P&L and Asset Statement.

5.4 FINANCIAL: CUMULATIVE CASH FLOW GRAPH

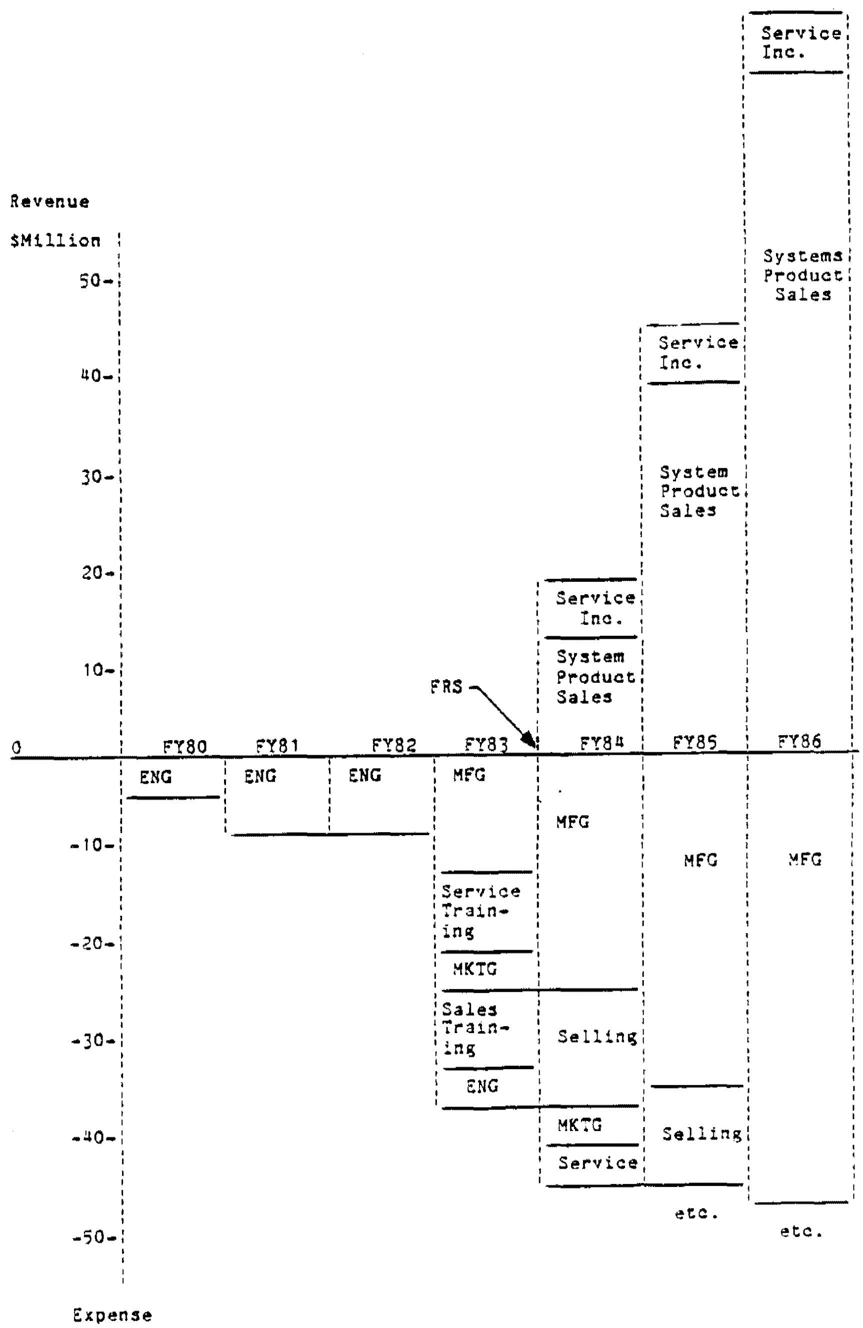
Plot after-tax cumulative Net Cash Flow by fiscal year. Indicate cash payback, and FRS (First Revenue Ship) points.



5.5 FINANCIAL: PRE-TAX REVENUE AND CASH OUTLAY BAR CHARTS

a. Revenue - plot NES, Service NOR, yielding total system NOR, converted to cash inflows by Fiscal Year.

b. Expense (negative cash flow) - show development expense, manufacturing start-up cost, transfer cost, service and warranty cost, inventory, receivables, and all other cash outflows yielding total pre-tax annual cash outlay.



5.6 FINANCIAL: BURP FINANCIAL STATEMENT

Include a copy of the standard BURP (Business Review Program) output.

For BURP Manual assistance, contact Engineering Finance, Product Investment Analysis, ML12-2/A16, DTN 223-0334.

5.7 FINANCIAL: SENSITIVITY ANALYSIS

Assumptions presented in subhead 4 discuss parameters for the riskier elements of the plan. This section explores reasonable bounds for fluctuation of the most critical assumptions, as best and worst case scenarios. You should be reasonably confident that actual performance will fall within these bounds.

For time-to-market, transfer cost, and other crucial assumptions highlighted, list the assumption, best and worst case bounds, and the degree to which they deviate from the plan. Also, summarize contingency plans.

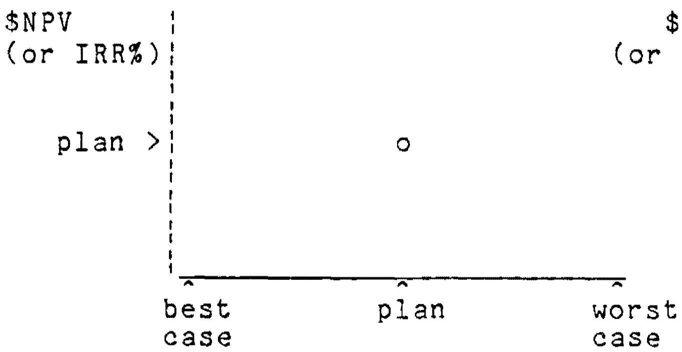
Include graphic summaries for critical sensitivities identified by analysis (for example, NPV versus FRS slippage, shifts in MTBF, mark-up, shipments, etc).

SENSITIVITY ($NPV or IRR%)

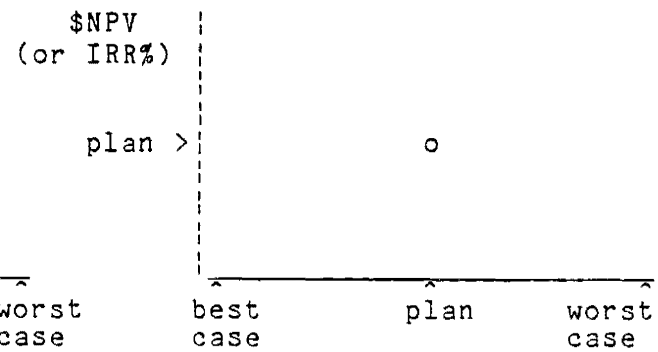
Assumptions	Best Case	Plan	Worst Case
Time-to-Market (Product avail. Date Q/FY)			
Transfer cost	$	$	$
# Units	#	#	#
Net Price (or discount structure) to customer	$	$	$
MTTR	hrs	hrs	hrs
MTBF	hrs	hrs	hrs
Inventory weeks	wks	wks	wks
Other			

$NPV or IRR% Sensitivity Graphs

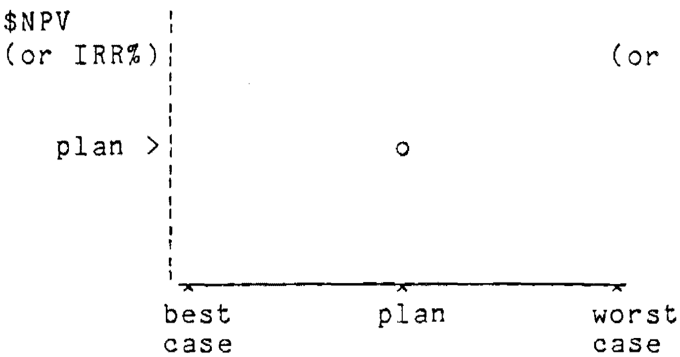
Time-to-Mkt/Prod.Avail.Date



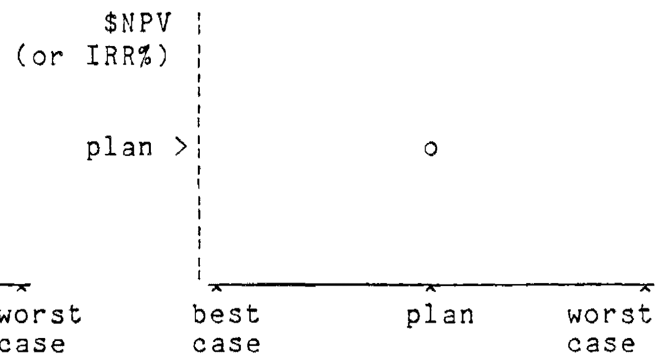
Transfer Cost



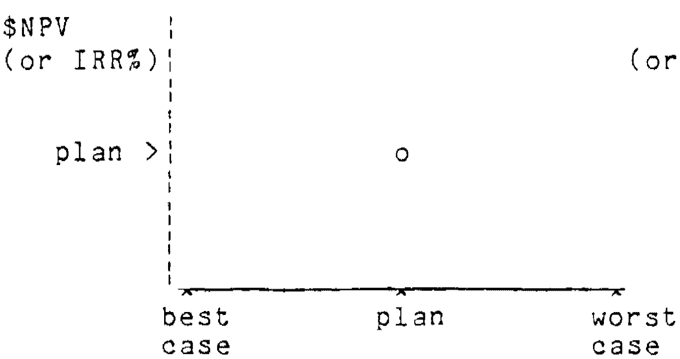
Units Shipped



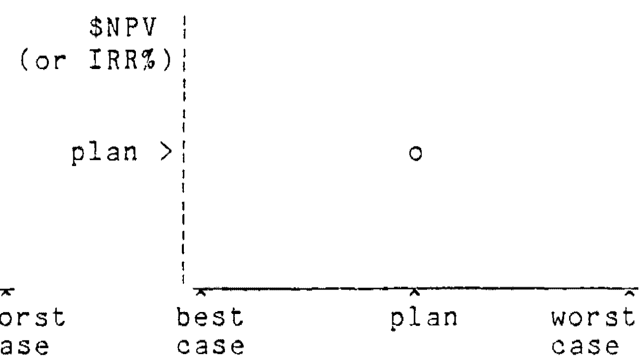
Price



Inventory Weeks



Mean-Time-Between Failures



6 REFERENCED DOCUMENTS

List applicable documents (for example, Manufacturing Plan, Customer Services Plan, Marketing Plan, Development Plan, etc.)

Title	Revision	Responsible Person	Date

7 BUSINESS PLAN HISTORY/CHANGES

For the initial plan and each subsequent revision, complete this form. The objective is to enable readers to quickly understand how the plan has been revised over time.

Dev. Phase	Rev. Date	Goals/ Description	Prod. Announcment	FRS	Phase Completion Dates						Avg. MLP/TC	Unit Ships Ext./Int.	%Gross Margin % NOR	IRR %	NPV @ 40 %	Total Development Budget		
					0	1	2	3	4	5						Eng.	Mfg.	Svce.

```
*****************
* d i g i t a l *
*****************

TO: ENG STAFF:                          DATE: MON 15 FEB 1982 6:55 AM EST
    JACK SMITH                          FROM: GORDON BELL
                                        DEPT: ENG STAFF
                                        EXT:  223-2236
                                        LOC/MAIL STOP: ML12-1/A51
```

SUBJECT: TASK FORCES, COMMITTEES; NOD; C-I T/F; PRODUCTIVITY REV.

I just read the minutes of two meetings of a task force called Customer Installability. It is not a task force it is a sewing circle consisting of 21 people! If there weren't 3 people there who I know have real work to do and have done good work, I would ask that we simply dismiss the whole group.

The minutes contain no real information on the subject. We already have a spec on what CI is, and we have to do some work on products to get it. This is not the work of a committee.

My point, I would like you to come forward with a list of the various committees and task forces, etc that are working within your group during the productivity review. I don't want to look at them, but I expect you to have, and I want to know that you understand what's going on in your area.

I believe 1/2 of these people could be let go from DEC today and our productivity would take a sharp rise. If this is the case, I would like to have their names and since we have the reputation for never firing anyone we can put them in a new group I propose we start called NOD (No Output Division) where they won't take time from people who have real work to do.
PS
I'm quite serious about NOD. Since it is so difficult to get rid of people, I want to make us at least not have them mixed in with the workers and suck up good people's time.

15-FEB-82 06:55:06 S 31987 BURT

This document is HISTORICAL and For Reference Only. It may not be applicable for new product development.

DIGITAL Standard 130-0 Product/Program Business Plan: Content Requirements and Format Guidelines

DOCUMENT IDENTIFIER: A-DS-EL00130-00-0000 Rev F, 26-Sep-2001

ABSTRACT: This standard describes the contents and format of DIGITAL business plans. This document supports DIGITAL Standard 028-0 Phase Management Policy, Rev D. This draft revision has been approved for interim use until reviewed by the general review group for its category. This document has been classified as historical and may not be applicable to new product development.

APPLICABILITY: This document has been classified as historical. This document previously applied to all product business plans, as specified in DIGITAL Standard 028-0 Phase Management Policy. The minimum requirements stipulated in this standard apply to all business plans and all items had to be addressed in the plan.

STATUS: HISTORICAL 26-Sep-2001

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DIGITAL Standard 130-0 Product/Program Business Plan: Content Requirements and Format Guidelines

DOCUMENT IDENTIFIER: A-DS-EL00130-00-0000 Rev F, 26-Sep-2001

REVISION HISTORY:	Rev A.	23-Jul-1977	
	Rev B,	03-Dec-1981	
	Rev C,	17-May-1985	ECO Number APO02
	Rev D,	16-Dec-1988	ECO Number CTO03
	Rev E,	04-Sep-1994	ECO Number NRO04
	Rev FX00,	01-Jul-1994	Rev FX00 was prepared as an interim draft to be used with Digital Standard 028-0 Phase Management Policy, Rev D.
	Rev F,	26-Sep-2001	DCN Number 02401 Rev F is prepared as a historical release to document that Rev FX00 was the last released version of this standard.

Document Management Category: Product Management Process Requirements (TPR)
Responsible Department: Corporate Standards Group
Responsible Person: Eric A. Williams
Corporate Standards Group Contact: Eric Falkof

APPROVAL: This document has been classified as historical.

Eric Williams – Corporate Standards Manager

Direct requests for further information to:

Eric Williams

To order copies of this document, or to provide comments regarding this document, access the Compaq intranet at http://standards.inet.cpqcorp.net/SMC/home.htm. For additional information, send e-mail to standards@compaq.com or call +1 978 506 7046.

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Digital Standard 130-0 Product/Program Business Plan: Content Requirements and Format Guidelines

DOCUMENT IDENTIFIER: A-DS-EL00130-00-0000 Rev FX00, 01-Jul-1994

ABSTRACT: This standard describes the contents and format of Digital business plans.

APPLICABILITY: This standard applies to all product business plans, as specified in Digital Standard 028-0 Phase Management Policy. The minimum requirements stipulated in this standard apply to all business plans and all items must be addressed in the plan.

STATUS: FOR REVIEW ONLY

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DRAFT

Digital Standard 130-0 Product/Program Business Plan: Content Requirements and Format Guidelines

DOCUMENT IDENTIFIER: A-DS-EL00130-00-0000 Rev FX00, 01-Jul-1994

REVISION HISTORY:	Rev A,	23-Jul-1977	
	Rev B,	03-Dec-1981	
	Rev C,	17-May-1985	ECO Number APO02
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	Rev E,	04-Sep-1994	ECO Number NRO04
	Rev FX00,	01-Jul-1994	Rev FX00 is prepared as an interim draft to be used with *Digital Standard 028-0 Phase Management Policy*, Rev D.

Document Management Category:	Product Management Process Requirements (TPR)
Responsible Department:	Central Engineering Operations
Responsible Person:	Jay Zager
SMC Contact:	Eric Falkof

APPROVAL: This standard has not yet been approved. Signatures are on file approving use of this draft.

Unsigned Review Copy

William Strecker - Central Engineering

Unsigned Review Copy

Jay Zager - Central Engineering Operations and Finance

Unsigned Review Copy

Lois Haskins - Corporate Finance

Unsigned Review Copy

Eric Williams - Standards Process Manager

Direct requests for further information to:

Karen Johnson
Use VTX ELF for the latest location information.

Use VTX SMC to order copies of this document from Standards and Methods Control. Send distribution questions to standards@digital.com or call DTN: 226-7058.

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CONTENTS

TABLES

1 Administrative Information

The following sections of this document describe each of the sections of the Business Plan. It is recommended that the section numbering match the section numbers assigned here, so that reviewers can easily refer to the specific sections that concern them.

1.1 Cover Sheet

The cover sheet includes the approvals appropriate for your organization. Minimum approvals include the Product Manager, the Operational Vice President or designee, and the Finance Manager (Controller). If approval delegation is authorized to a designee, written authorization is included in the product file. Additional approvals may be required as specified by the Operational Vice President or by the Corporate Approvals Policy, Section 301-10 of the *Corporate Accounting and Reporting Manual*.

The following is an example of a cover page:

```
---------------------------------------------------------------------

Product: PRODUCT or FAMILY NAME
         Business Plan

Phase:   PS Product Specification

Prepared by:  __________________________________________________
              Name, Title, Date

Approvals:

Product Manager:  ________________________________________________________
              Name, Title, Date

Finance Manager:  ____________________________________________________
                  Name, Title, Date

Product Segment or Business Unit
Vice President or designee:  ________________________________________
                              Name, Title, Date

---------------------------------------------------------------------
```

Additional approvals may be required as specified by the Operational Vice President or by the *Corporate Approval Policy*.

If a corporate review is required for either approving the commitment to begin the program or to begin product End-of-Life and divest the program, use the checklist and templates in Appendix B.

1.2 Table of Contents

A table of contents is an essential aid to your reader. The following outline lists the contents of the Business Plan.

Table 1: Business Plan Outline

Section Number	Section Title
1	Administrative Information
1.1	Cover Sheet
1.2	Table of Contents
1.3	Revision Control and List of Changes
1.4	Waivers
2	Product, Program, or Project
2.1	Overview of Product, Program, or Project
2.2	Product Description
3	Market Opportunity and Competition
3.1	Market Opportunity and Pricing
3.2	Competition
4	Product, Program, or Project Commitments
4.1	Schedule, Major Milestones, and Metrics
4.1.1	Milestones for VRS Date and Completion Dates of Subsequent Phase Commitments
4.1.2	Engineering Spending
4.1.3	Product, Program, or Project Spending (by Function)
4.1.4	Product Cost (Manufacturing Competitive Value and Transfer Cost Metrics)
4.1.5	Quality
4.1.6	Performance
4.1.7	Third-Party Cash Payment Schedule (If Appropriate)
4.1.8	Other Commitments
4.2	Major Dependencies and Commitments
5	Risks and Issues
6	Functional Analysis
6.1	Engineering Scope and Investments
6.2	Manufacturing Scope and Investments
6.3	Service Scope and Investments
6.4	Marketing and Sales Operations Scope and Investments
7	Financial - Profit and Loss Statement and Volumes
7.1	Summary of Business Units Volume Plans and Projections by Channel and Geography
7.2	One Page Financial Summary and Commentary, Including Sensitivity Results
8	Disposition Analysis
8.1	Triggers for Disposition Analysis
9	Appendix

NOTE

Phases specified in the descriptions indicate the first phase in which the section will appear. These sections will not be revised in subsequent phases unless there are changes. The changes will be highlighted in Section 1.3 of the Business Plan.

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1.3 Revision Control and List of Changes

Phase Required: PS (Product Specification) and all subsequent revisions of the Business Plan

This subsection includes the revision control number (document version number), a revision history (list of any changes that were approved in prior phases), and changes being proposed in the current phase and for which approval is sought.

1.4 Waivers

Waivers are granted if functional plans are not available when the Business Plan is being completed. The waiver is written and presented for approval with the Business Plan, Product Specification, and commitments. Waivers require the same approvals as the Business Plan, Product Specification and commitments. The waivers should be approved by the Engineering or Operational Vice President, the Vice President of Engineering, the Chief Technology Officer, and the Business Unit Vice President. The waiver should include follow-up dates for expected completion of the missing plans, or a contingency plan if the plans will never be available.

The waiver should not be used as the first notice of a lack of participation or other functional issue. These types of issues should be escalated within the functional organization as soon as it becomes apparent that the product team has not achieved resolution. The waiver process is intended to prevent delays in the product schedule if lack of participation issues have been reported but not resolved within the functional organization.

2 Product, Program, or Project

The following subsections describe the product, program, or project and its relationships to product families, if any. This information is required for Phase PS (Product Specification).

2.1 Overview of Product, Program, or Project

The overview introduces the products and, for a family Business Plan, clearly identifies:

- The broad family or architecture definition
- All products within the family
- The subset of products for which commitments are being made and approvals are being sought

A product family is defined as two or more products sharing a common effort to design, qualify, support, build and ship. Combining these products as a family must be consistent cross-functionally, and all functions must agree to manage them as a family. The Business Plan for Top-100 products, including financial information, addresses the product family and the subset of products being planned. For other types of products, financial information for the product family, or a group P&L, is required.

2.2 Product Description

The product description includes:

- A list of the major capabilities and features, as detailed in the Product Specification and recorded in the Engineering Product Information and Commitments (EPIC) database.
- An overview description of the configurations being offered. For components, list the systems that will be primary hosts.
- Licensing information (standard or unique terms, Digital and third party). Describe the product licensing recommendation. Explain any possible issues of using this particular license scheme in relation to the business practices of Digital and its competition.
- Packaging. Describe the packaging recommendation for this product. Explain any possible issues with the package relative to its position in the Digital portfolio as well as against competition.
- Substitution, replacement or effect on other Digital products. If this is a replacement product, what is your migration strategy? What will replace this product and when?
- A list of service offerings that relate to this product.
- A summary of the high-priority product requirements and the related competence evaluation and the sourcing strategy. What is being externally sourced, from whom, and why? What is the agreement with the vendor? How does this support Digital's business and technical objectives?

3 Market Opportunity and Competition

The following subsections describe the market for which the product, program, or project is intended.

3.1 Market Opportunity and Pricing

This subsection enables the reader to quickly assess the viability of the business or product and its chances for commercial success.

Describe the overall market, market segmentation, and the target market for this business. Discuss the customer needs and benefits that provide the opportunity for economic gain to Digital. Describe the product in the context of the specific market opportunity being pursued, as well as the market's size and growth rate. For a product family, identify the market covered by the broad family or architecture, if the family market is broader than the phasing products.

Describe the marketing strategy and identify the specific market goals with a clear indication of the product's fit and importance to Digital's overall product strategy. Discuss any significant impact and effect on other Digital products or families.

Include product and service proposed pricing, internal and external positioning. Identify the major considerations, assumptions, or constraints that determine the product pricing. Indicate the manufacturer's list price (MLP) of the major configurations. Software products will refer to current standard price tiers, or per-user pricing, as appropriate. Provide business reasons for nonstandard prices. Describe how pricing will change over the lifetime of the product.

3.2 Competition

This subsection briefly identifies the major competitors for the product and applicable services and describe how this product will be able to compete effectively with them. Use of comparison graphs or charts is helpful. A template file is available for this section of the Business Plan. See Appendix C for information about how to obtain the template file.

Briefly describe the market strategies, strengths, and weaknesses of each of the major competitors, in the time frame of your product's introduction. Discuss them in terms of the specific opportunities and challenges that they offer to Digital. What are the anticipated competitive moves? How will these impact this program? Include the following information about each competitor:

- Stated strategy and strategic intent
- Service strategy
- Distribution strategy of competitors
- Make or buy strategies
- Main (core) competencies and sourcing strategy
- Main product or package offerings
- Penetration of various segments and goals in each
- Business model (For example, Competitor 2 focuses on name recognition, rather than profit, as a first priority.)
- Profitability or operating profit and margins

Include any risks that Digital is taking by competing with this vendor.

How does Digital win against the competition in this market? How does Digital differentiate its offering from that of its competitors? Indicate the range of opportunities.

4 Product, Program, or Project Commitments

The following subsections describe each of the project commitments.

4.1 Schedule, Major Milestones, and Metrics

The subsections that follow include Volume Revenue Ship (VRS), product, program, or project spending, product cost, quality and performance minimums, third-party cash payment schedules, if any, and any other commitments that may have been specified in the Product Planning Process and the Product Specification.

4.1.1 Milestones for VRS Date and Completion Dates of Subsequent Phase Commitments

This subsection includes:

- the date when the product or service will be available for VRS
- the date when the team expects to be ready to make commitments for appropriate subsequent phases

These metrics may have a range. The ranges for VRS date for each phase are described in Table 2.

Table 2: VRS-Date Ranges

For Phase	If VRS is	Range is
PS	More than 12 months away	6 months (maximum)
	Less than 12 months, but more than 6 months away	3 months (maximum)
	Less than 6 months away	No range allowed
PD		No range allowed

4.1.2 Engineering Spending

Table 3 describes information required for PS Phase and PD Phase.

Table 3: Engineering Spending

Phase Required	Description
PS	Engineering Spending range is submitted by the product team and approved by the Engineering or Operational Vice President or designee based on their own budgetary or other constraints, if the spending was not established in the Product Planning Process. It is then approved by the Product Segments or Business Units as part of the Business Plan.
PD	The Engineering Spending range is approved by the Engineering or Operational Vice President or designee based on their own budgetary or other constraints, if the spending was not established in the Product Planning Process. The committed range will not exceed 15%.

4.1.3 Product, Program, or Project Spending (by Function)

Table 4 describes the information required for PS Phase and PD Phase.

Table 4: Product, Program, or Project Spending

Phase Required	Description
PS	Program Spending range is submitted by the product team and approved by the functional managers, based on their own budgetary and resource constraints. It is then approved by the Product Segments or Business Units as part of the Business Plan.
PD	Program Spending range is approved by the functional managers, based on their own budgetary and resource constraints. The range will not exceed 15%.

4.1.4 Product Cost (Manufacturing Competitive Value and Transfer Cost Metrics)

Table 5 describes the information required for PS Phase and PD Phase.

Table 5: Product Cost

Phase Required	Description
PS	Product cost (actual) and Manufacturing Competitive Value. If a range was not established in the Product Planning Process, the product team can submit a range that the Engineering or Operational Vice President, or designee, approves. It is then approved by the Product Segment or Business Units as part of the Business Plan.
PD	The Manufacturing organization recommends that the range not exceed 5%.

4.1.5 Quality

Table 6 describes the information required to describe product quality during Phase PS.

Table 6: Product Quality

Phase Required	Description
PS	Quality minimums, including MBTF (Mean Time Between Failures), MTTI (Mean Time To Install), MTBC (Mean Time Between Calls), and so forth.

4.1.6 Performance

Table 7 describes information that is required for Phase PD.

Table 7: Product Performance

Phase Required	Description
PD	Include performance metrics relevant to the product, using industry-standard benchmarks like SpecINT, SpecFP, and TPC. If a range was not established in the Planning Process, the Engineering or Operational Vice President or designee or the functional manager may set one, or the team can submit minimums only.

4.1.7 Third-Party Cash Payment Schedule (If Appropriate)

Table 8 describes the information required for Phase PS and Phase PD.

Table 8: Third-Party Cash Payment Schedule (If Appropriate)

Phase Required	Description	Certainty Estimate
PS	If cash payments or royalties are required, list the name of the third-party vendor, timing, and amount of payments.	Provide certainty estimate (for example, 75% certainty on amount, 100% certainty on timing).
PD	If cash payments or royalties are required, list the name of the third-party vendor, timing, and amount of payments.	If certainty in timing or amount is not 100%, follow the waiver process.

4.1.8 Other Commitments

Product Segments or Business Units may require further commitments as they see appropriate.

4.2 Major Dependencies and Commitments

This subsection lists key dependent organizations that are critical to delivery of the product on schedule[1]. Specific development or implementation items that are consistent with goals are also described.

If applicable, describe relationships with other key businesses. How is this business coordinated with other businesses? Identify the major demands that will be placed on other groups for the successful development, production, quality, and marketing of this business, including engineering, business management, field, support, and marketing organizations, as well as third-party vendors.

5 Risks and Issues

This subsection examines the assumptions on which the success of the program or product is based and on which the plan's market and financial projections achievement depend. Describe the plan to manage or resolve each risk and issue. If there are key applications required for success, identify them, indicating the strategy to address third-party vendor systems, tools, and applications. Be specific where third-party relations can have synergistic effects and where they are not beneficial to Digital. Include strategic work with consortia and standards bodies. A template for creating the Risks and Issues subsection is available. See Appendix C for information about how to obtain the template file.

6 Functional Analysis

The functional sections of the Business Plans cover key functional issues and are extracted from the detailed functional plans whenever possible.

6.1 Engineering Scope and Investments

Table 9 describes the Engineering scope and investment information required for PS Phase and PD Phase.

Table 9: Engineering Scope and Investments

Phase Required	Description
PS	Resource requirements not addressed in Section 4.1.2, including capital costs and human resources, engineering scope (key programs and work), and planned changes or additions to design methodology. The Engineering Scope Statement describes technological impact, technical requirements, legal protection requirements (patents), trade-off decisions requiring resolution, and reuse and concurrency opportunities.

[1] Items that will be considered, if applicable, are attributes like installability, compatibility, and interoperability with hardware base, peripherals, operating system, other layered components, and general usage patterns.

Table 9 (Cont.): Engineering Scope and Investments

Phase Required	Description
PD	Highlight any resource requirement changes from the PS Phase document in Section 1.3. Include a summary of the make or buy decision.

6.2 Manufacturing Scope and Investments

Table 10 describes the Manufacturing information required for PS Phase and PD Phase.

Table 10: Manufacturing Scope and Investments

Phase Required	Description
PS	New Product Start Up (NPSU) cost, if available. If other new investments (new plant, new technology line, and so forth) are required, they will be introduced in this section, even if no financial information is included. Include the design for manufacturing plans.
	Manufacturing Scope (key programs and work), capital and other manufacturing costs
PD	Define and summarize investment costs not provided during PS Phase, including manufacturing capability, worldwide process strategies and technologies, sourcing strategy, capital, and NPSU cost, if applicable, as well as any other investments.

6.3 Service Scope and Investments

Table 11 describes the Service information required for PS Phase and PD Phase.

Table 11: Service Scope and Investments

Phase Required	Description
PS	Include development and delivery of training and documentation.
	Service Scope (key programs and work). Include the design for serviceability plans.
PD	Define the service delivery model that applies to this product or family. For example: terminals, desktop, middle or low-end system, high-end system, or other. Define any new or unique service delivery elements or models that may be required, including design for serviceability.
	Training Requirements: List any training offerings necessary to be competitive in this market.

6.4 Marketing and Sales Operations Scope and Investments

Table 12 describes the Marketing information required for PS Phase and PD Phase.

Table 12: Marketing and Sales Operations Scope

Phase Required	Description
PS	Include any marketing or announcement efforts are to be developed specifically targeted to this product or family. Marketing Scope (key programs and work)
PD	The Marketing Scope will include: • Channels Plan: Describe the channels through which your products will be marketed, sold, delivered, and supported. • Announcement Plan: Describe the announcement plan and how it provides notification, both internally and externally, of the upcoming program or product. List business reasons for announcing at the proposed date (for example, integrated announcement, early to hold market, important trade show for maximum impact, product available in volume, and so forth). In addition, for new products, briefly identify the promotion content and schedule. Identify product specific environmental marketing claims. • Marketing programs, special work required, related timeframes. • Advertising • Education or training required, including who is responsible, how much it costs and what the training requirements are. • Information Management and Technology requirements (if any) for ordering, shipping, and billing. • Competitive incentives, if any.

7 Financial - Profit and Loss Statement and Volumes

The following subsections describe the financial information to be supplied.

7.1 Summary of Business Units Volume Plans and Projections by Channel and Geography

Table 13 shows the format for the volume plan summary that is supplied during PS Phase.

Table 13: Business Unit Volume Plans (PS Phase)

	Current Fiscal Year (FY)	FY +1	FY +2	FY +3	FY +4	Life
Volumes: Worldwide Total Units[1]						
U.S. - Direct						
U.S. - Indirect						
Europe - Direct						
Europe - Indirect						
Asia/Pacific/Americas - Direct						
Asia/Pacific/Americas - Indirect						

[1]Net Operating Revenues (NOR) can be used if units are not appropriate. Please label accordingly.

Volume plans (in units and NOR for systems, or NOR for other types of products) will reflect the official Corporate Demand Plan Approved volumes. If the Demand Plan does not forecast the specific product in development (that is, the product is included in a broader category), the volumes used in the Business Plan must be independently reconciled as follows:

For all Top-100 products, the Product Segment or Business Unit will provide volume detail for all Top-100 products included in a broader category. If the Business Plan extends beyond the years provided in the Demand Plan, the Product Segment or Business Unit will provide the necessary volumes.

For other types of products, report volumes (or NOR) for the family or group in which the product is included. Volume plans by territory should be included, if available.

7.2 One Page Financial Summary and Commentary, Including Sensitivity Results

Table 14 shows the format for the P&L statement for the preliminary Business Plan required for PS Phase.

Table 14: One-Page Financial Summary (PS Phase)

	Worldwide P&L $ =					
	Current FY	FY +1	FY +2	FY +3	FY +4	Life
Initial System Sales (ISS) for Hardware						
Total Systems Sales (TSS) for Software						
Units						
Gross MLP						
(Use standard factors if available)						
NOR						
NOR % MLP						
Gross Margin						
%NOR						
(Use standard factors for group, if available)						
Operating Margin						
%NOR						
Cash Flow						
IRR %						
Payback Period						
TSS P&L (if available)						
Services P&L (if available)						
Breakeven Volumes:						

NOTE

The Finance organization will include an objective opinion of the the soundness of the assumptions upon which the financial figures are based, and the results of sensitivity analysis. Sensitivity analysis in PS Phase will represent an average of the range parameters. In PD Phase, sensitivity analyses will be performed for upper and lower limits of the ranges. If any other activities were considered critical, the results and a brief discussion of their importance will be provided.

8 Disposition Analysis

This subsection discusses the reasons for phasing down the product. For example, a replacement product will be ready, declining volumes would no longer support the asset base, product no longer competitive, and so on. It identifies other products, services, or third-party contracts that would be impacted by product phase-down.

If applicable, this subsection discusses product End-of-Life and disposition considerations for situations where external alternatives are pursued during product End-of-Life.

8.1 Triggers for Disposition Analysis

Provide specific metrics and actions. For example, if volumes are 30% less than plan for two consecutive quarters, describe the following:

- The analysis that will be conducted and a recommended provided within the third quarter
- Estimated technology life
- Market life or service life

9 Appendix

The appendix in the Business Plan will be used for a minimum of additional information, such as the list of project team members, location of, or pointers to related project, program, or product documentation and specifications, financial sensitivities, graphics and charts of essential details in the body of the Business Plan. The Product Team List and Functional Plan Directory do not have to be attached, but pointers or instructions for obtaining them must be included.

9.1 Product Team

List the product team members using the sample form below as a guide, modifying it as appropriate for your team.

Function	Title	Name	E-Mail Address
Any Function	Team Leader		

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Function	Title	Name	E-Mail Address
Engineering	Engineering Project Manager		
	Program Manager		
	Engineering Manager		
	Designers		
	Field Test and Diagnostics		
	Financial Manager		
	Quality Manager		
	Documentation Manager		
Manufacturing	Manufacturing Project Manager		
	Volume Manufacturing		
	New Product Start Up		
	Manufacturing Finance		
Process Management	Manufacturing Engineering		
Digital Services	Service Product Manager		
	Service Delivery Manager		
	Customer Training		
	Logistics		
Marketing Team Leader	Product or Program Manager		
	Product Marketing Groups		
	Industry Marketing Groups		
	Channels Marketing		
	Services Marketing		
Field Sales	Field Sales		
Legal	Product Group or Project Legal Counsel		
Others (Identify)			

9.2 Functional Plan Directory

Provide a list of functional plans that are available (for example, Marketing, Manufacturing, Engineering, Services, Sales), including the name of the author, the date of publication and information about how to obtain copies of the functional plans. The functional plans will not be attached to the Business Plan unless specifically requested by a reviewer.

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APPENDIX A SAMPLE BUSINESS PLAN FINANCIAL SUMMARY

Table 15 shows a sample Financial Summary table for a Business Plan.

Table 15: Sample Business Plan Financial Summary

Product Phase				$ =			
PR	FY91	FY92	FY93	FY94	FY95	FY96	Life
Initial System Sales							
Units	0	0	4000	44000	20000	0	68000
Gross MLP	0	0	60	655	267	0	982
Standard factors to NOR							
NOR	0	0	49	544	221	0	815
NOR % MLP	0%	0%	83%	83%	83%	0%	83%
Gross Margin	0	0	14	317	87	0	317
%NOR	0%	0%	27%	40%	39%	0%	39%
Operating Margin (standard factors)	0	-4	-28	34	16	0	18
%NOR	0%	0%	-56%	6%	7%	0%	2%
Cash flow							
IRR%							16%
Payback Period							4 Quarters
Breakeven Volumes							37500
Services P&L (if available)							

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APPENDIX B CORPORATE LEVEL REVIEW—SUMMARY FORMATS AND FINANCE CHECKLIST

B.1 Standard Proposal Documentation

- Proposal Summary

  Required. Please see Section B.2 for investments and Section B.3 for divestments.

- Financial Checklist

  Required. Please see Section B.4 for investments and Section B.5 for divestments.

  This statement of support must be from the Senior Controller of the proposing organization (that is, a direct report of the Vice President Corporate Controller or Chief Finance Officer).

- Copy of the Business Plan

  Required. Should address the standard topics, including:

  — Clear statement of SLT Vice President sponsorship

  — Objectives of proposal

  — How proposal supports strategy

  — Impact on proposer's and sponsor's Plan of Record

  — Risks and issues

  — Implementation responsibilities and considerations

  — Annual Profit and Loss Statements, Balance Sheet, Cash Flow Statement

  — Assumptions Worksheet (refer to *Corporate Approval Policy* for suggested format)

- For any external investment proposal requiring corporate level approval, policy 310-05 on VTX (guidelines section of *Corporate Approval Policy* should be utilized in preparing the the Proposal Summary, Finance Checklist and Financial Subsection of the overall Business Plan.

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B.2 Attachment A, IC/BOD Investment Proposal Summary

The two pages of Section B.2 describe the investment proposal summary business information and financial information.

B.2.1 Investment Proposal Summary: Page 1 of 2

```
Topic:              Date:

SLT Sponsor:                Presenter:

Purpose/requested decision or action:


Overview: Brief summary of the business rationale


Alternatives considered:


Other Digital units impacted:

Issues
```

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B.2.2 Investment Proposal Summary: Financial Information, Page 2 of 2

```
Name of Unit making financial commitment:

Numerical Summary:  (By FY, at the highest level of business unit)
                                   ($M)
                    FY__    FY__   FY__   FY__     FY__   Total
Investment

Revenue
     Original Commit
     Effect of Proposal
     New Commit

Profit Before Tax
     Original Commit
     Effect of Proposal
     New Commit

Cash Flow
     Original Commit
     Effect of Proposal
     New Commit


IRR*
Payback Period


Written by <insert sponsor name and title>, who reports to Robert B.
Palmer, President and Chief Executive Officer.
```

(* Note: All **external investment** proposal analyses should be completed for two scenarios:

1. IRR without terminal value
2. IRR with terminal value

Reference CARM 310-05 External Investment: Financial Content p. 18 for details and definition.)

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B.3 Attachment B - Investment Committee Divestment Summary Format

- Program Name
- SLT Sponsor
- Designated Divestment Manager - must have no personal stake in the outcome.
- Description - What it is. Brief History.
- Business Rationale - Why divestment makes sense. How this fits the strategy. Comparison to basic 'close' alternative.
- Customer Impact (if applicable)
- Impacted Organizations/Units - (Other than proposer)
- Proposed Terms - We set, they get...parameters...when.
- Current Value
  - Book
  - Market
  - Contingencies
- Operating Plan Tie-in - What impact does this have on the plan of record... current year, next year deliverables and financial commitments?

Written by <insert sponsor name and title>, who reports to Robert B. Palmer, President and Chief Executive Officer.

NOTE

Not all of the above information may be known at preliminary review stage, but would be needed for final approval.

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B.4 Attachment C - Finance Checklist: Investments

NOTE

To be completed by a Corporate Controller direct report.

The two-page finance checklist for investments is shown below.

B.4.1 Operations Finance Staff IC Review Checklist - Investments (Page 1 of 2)

This document is to be completed and signed by a Corporate Controller direct report. It may be forwarded electronically from the direct report's account or delivered hardcopy to the Investment Committee Secretary.

```
                                                             Y      N
1. Do you personally support the proposal as submitted?

Comments: (leave blank to indicate no comments)

2. Do you believe that the stated financial returns will
be achieved?

Comments:   [Blank = "no"]

3. What is the degree of confidence you personally have
in achieving the stated financial returns?

4. Is there anything about the methodology used in
calculating the financial returns that should
be discussed?

Comments:

5. Have you discussed the accounting treatment with the
Accounting group?

Are there any accounting issues?

Comments:   [Blank = "no"]

6. Have you discussed currency and volatility/inflation
issues with Treasury?

Are there any issues?

Comments:   [Blank = "no"]

7. Are there any open issues the Investment Committee
should be aware of?

Comments:

8. Will the proposal impact the financial
performance of other Business Units?

If yes, have those issues been worked?

Comments:  [Blank = "no"]
```

B.4.2 Operations Finance Staff IC Review Checklist - Investments (Page 2 of 2)

Y N

9. Does your plan of record reflect the impact of this proposal?

Comments:

10. What are the three greatest risks to the project?

1.
2.
3.

11. What are the greatest opportunities from the project?

Comments?

12. Please discuss any other relevant factors not discussed above.

Finance Staff Signature:_______________________

Date:______________________

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B.5 Attachment D - Finance Checklist: Divestments

The two-page finance checklist for divestments is shown below.

B.5.1 Operations Finance Staff IC Review Checklist - Divestments (Page 1 of 2)

This document is to be completed and signed by a Corporate Controller direct report. It may be forwarded electronically from the direct report's account or delivered hardcopy to the Investment Committee Secretary.

```
                                                            Y       N

1.  Do you personally support the divestment as proposed?

Comments:

2.  Do you believe that this is no longer a strategic
asset for the business?

Comments:

3.  Do you believe there any potential risks to Digital
in the future associated with this divestment? (legal,
technological, and so forth)

Comments:   [Blank = "no"]

4.  Will this divestment impact the financial performance of
other Business Units or functions?

If yes, have those issues been worked?  [Blank = "no"]

5.  What methodology was used to establish the selling
price?

6.  Have you discussed the accounting treatment for the
divestment with the Accounting Group?
              - Will there be an a write-off?
              - Is there an established reserve?
              - Are there any other issues?

Comments:

7.  Have you discussed terms of the Divestment with Treasury
(including Tax)?
               - Are there any issues?

Comments: [Blank = "no"]
```

B.5.2 Operations Finance Staff IC Review Checklist - Divestments (Page 2 of 2)

Y N

8. Have you discussed terms of the Divestment with Law?
   - Are there any issues?

Comments: [Blank = "no"]

9. Were the returns committed in the original proposal realized?

Comments: [Blank = "no"]

10. Are there any open issues the Investment Committee/CCH should be aware of?

Comments:

11. What were the three most important learnings from this investment?
    1)
    2)
    3)

12. Please discuss any other relevant factors not discussed above.

Finance Staff Signature:_______________________

Date:______________________

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APPENDIX C REFERENCED DOCUMENTS

C.1 Digital Documents, EL-Class

Document Number	Document Title
EL-00028-00	*Digital Standard 028-0 Phase Management Policy*
EL-00028-01	*Digital Standard 028-1 Corporate Product Phase Down*
EL-00128-00	*Digital Standard 128-0 Security Classifications for Engineering Intellectual Property—Policy and Regulations*

C.2 Digital Documents, Other Than EL-Class

Document Number	Document Title
CARM 310-05	*External Investment: Financial Content*
CARM 310-10	*Corporate Approval Policy*

C.3 Ordering Information

Use VTX SMC to order copies of EL-class Digital documents from Standards and Methods Control. Send distribution questions to standards@digital.com or call DTN: 226-7058.

See VTX CORPFIN for information about the *Corporate Accounting and Reporting Manual* (CARM). Copies may also be available from your local Digital library.

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GLOSSARY

A/O: Add-ons

IC/BOD: Investment Committee/Board of Directors

IQ Phase: Implementation and Qualification Phase

IRR: Internal Rate of Return

ISS: Initial Systems Sales

Electronic Approval: The process by which approval for a plan is requested and granted. The documentation is forwarded to the approver using electronic mail. Approval is appended to the document and sent to the originator and any other approvers.

MLP: Maynard/Manufacturing List Price

NOR: Net Operating Revenue

NPSU: New Product Start Up cost

OP: Operating Profit

P&L Statement: Profit and Loss Statement

PD Phase: Planning and Design Phase

PoR: Plan Of Record

PR Phase: Product Requirements Phase

PS Phase: Product Specification Phase

ROA: Return on Assets

SSD Phase: Steady State and Product Disposition Phase

SOP: Sum of the Pieces

SpecINT: Industry-standard benchmark for rating computer systems.

SpecFP: Industry-standard benchmark for rating computer systems.

TPC: Industry-standard benchmark for rating computer systems.

TS Phase: Transfer to Services, Other, or Service End-of-Life Phase

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C O M P A N Y   C O N F I D E N T I A L

ENGINEERING ORGANIZATION CHART

Updated: 7/14/83

VICE PRESIDENT, ENGINEERING, (Gordon Bell)
VICE PRESIDENT, ASSOCIATE HEAD ENGINEERING (Jack Smith)
¶
¶SENIOR GROUP MANAGER, CORPORATE RESEARCH & ARCHITECTURE (Sam Fuller)
¶ ¶
¶ ¶----Manufacturing Automation Program (Tom Williams)
¶ ¶----West Coast Research Lab (Forest Baskett)
¶ ¶----Advanced Systems Research (Bob McKenzie)
¶ ¶----External Research Program (Dieter Huttenberger)
¶ ¶----Standards (Gary Robinson)
¶ ¶----Systems & Technology Analysis (Linda Wright)
¶ ¶----Operations & Planning (Bill Svirsky)
¶ ¶----Exploratory Research (Charle Rupp)
¶ ¶----MCC/CSM (Tom Gannon)
¶ ¶....Personnel (Maureen Harvey)
¶ ¶....Finance (Donna Berard)
¶ ¶....Software Architecture & Technology (Mahendra Patel)

¶VICE PRESIDENT, SYSTEMS AND COMMUNICATIONS ENGINEERING (Bill Johnson)
¶
¶ ¶----32 Bit Systems,Vice President (Bill Demmer)
¶ ¶----Large Systems Engineering, Vice President (Ulf Fagerquist)
¶ ¶----Distributed Systems, Group Manager (John Adams) (Acting)
¶ ¶----Base Systems Software, Group Manager (Bill Heffner)
¶ ¶----Vax Workstations, Manager (Brian Croxon)
¶ ¶----Technical Director (Mahendra Patel)
¶ ¶....Finance (Steve Behrens)
¶ ¶....Personnel (Les Koch)
¶ ¶----Hardware Process (John Manzo)
¶ ¶----Staff (Will Thompson)
¶ ¶----Large VAX Engineering Manager (Bob Glorioso)
¶ ¶----SAC Operations (Acting) (Bill Johnson)
¶ ¶----Central Quality Group Manager (Steve Beason)
¶ ¶----European Engineering Manager (Dave Stone)
¶ ¶----Large Systems Integration Manager (Walt Manter)

¶VICE PRESIDENT, GROUP MANAGER, LOW-END ENGINEERING (Jim Cudmore)
¶
¶ ¶----DECmate Development Group (John Clarke)
¶ ¶----Electro Mechanical Development & Support Group (Walt Hanstein)
¶ ¶----Rainbow Development Group (Barry James Folsom)
¶ ¶----CT Development Group (Ron Ham)
¶ ¶----PDP-11 Systems Development Group (Mike Gutman)
¶ ¶----Terminals Development Group (Bill Avery)
¶ ¶----MicroVAX Program Manager (Roy Moffa)
¶----Group Personnel Manager (Dot Terrell)
¶ ¶----Group Finance and Administration Manager (Pat Spratt)

C O M P A N Y   C O N F I D E N T I A L
ENGINEERING ORGANIZATION CHART

¶GROUP MANAGER, LSI (Jeff Kalb)

```
¶
¶   ¶----Group Manager, Acquisition & Testing (Dan Hamel)
¶   ¶----LSI Marketing Manager (Steve Rothman)
¶   ¶----HL Manufacturing Manager (Rod Schmidt)
¶   ¶----LSI SEG Manager (Steve Teicher)
¶   ¶----LSI Personnel Manager (Ellen Ober)
¶   ¶----Group Controller (Bob Hranek)
```

¶GROUP MANAGER, PROCESS & DESIGN SUPPORT (Don Metzger)

```
¶
¶   ¶----Group Manager, Technical Service Group (John Rose)
¶   ¶----Group Manager, Design Process (Pete Straka)
¶   ¶----Manager, Operations Support (Al Erny)
¶   ¶----Group Manager, Process Design Engineering (Dave Thorpe)
¶   :....Personnel Manager (Willow Shire)
¶   :....Finance Manager (Dick Haslett)
```

¶VICE PRESIDENT, STORAGE SYSTEMS DEVELOPMENT (Grant Saviers)

```
¶   ¶
¶   ¶----Engineering Manager, SSD Japan (Vince Bastiani)
¶   ¶----Tape Product Development, Shrewsbury Host Manager (Dave W. Brown)
¶   ¶----Very Small/Small Disk Product Development (Paul Bauer)
¶   ¶----Advanced Technology and Storage Components (Mike Riggle)
    ¶----Central Staff/Operations (Bob Flynn)
"   ¶----Medium/Large Disks and Subsystem Product Dev. (Tom Burniece)
¶   ¶----SSD/EPIP, Special Projects (Jim Lacey)
¶   ¶....Personnel (Lee Hayes)
¶   ¶....Finance (Ed Sawyer)
¶   ¶----Electronic Storage Development, Group Manager (Pete van Roekens)
¶   ¶----Japanese R & D Center (Tom Kobayashi)

¶
```

¶GROUP PERSONNEL MANAGER, ENGINEERING/MANUFACTURING (Larry Bornstein)

¶

¶CORPORATE PRODUCT MANAGEMENT (Rick Corben)

¶

¶VICE PRESIDENT, ENGINEERING FINANCE (George Chamberlain)

```
:   :----Engineering Finance Group Controller (Joe Reilly)
```

GB5.2

GB5.2

```
+---------------------------+
|   |   |   |   |   |   |   |
| d | i | g | i | t | a | l |   i n t e r o f f i c e   m e m o r a n d u m
|   |   |   |   |   |   |   |
+---------------------------+
```

Subject: **Make vs Buy Guidelines Update (from 3/5/76)**

To: File

Date: 3/28/79
From: Gordon Bell
Dept: OOD
Loc: ML12-1/A51 Ext: 223-2236

What DEC SELLS not what it BUILDS is the more important issue for continuing success. In a rapidly changing industry where technologies can quickly become obsolete, it is essential that DEC maintain flexibility and not become over committed to any particular technology or process. As we make more and more of the items we sell, we become more rigid. Opportunities in the marketplace can be delayed or lost forever. Opportunities to cost reduce by building more inside will stay with us. The following guideline is intended to help us focus on these issues.

1.DEC wants to build unique products that offer specific advantages to its customers. Profitability alone is not sufficient.

2.High ROI by itself is no reason to build anything (e.g., it robs resources from other, more essential projects).

3.The general rule should be, if we don't make it now, buy it.

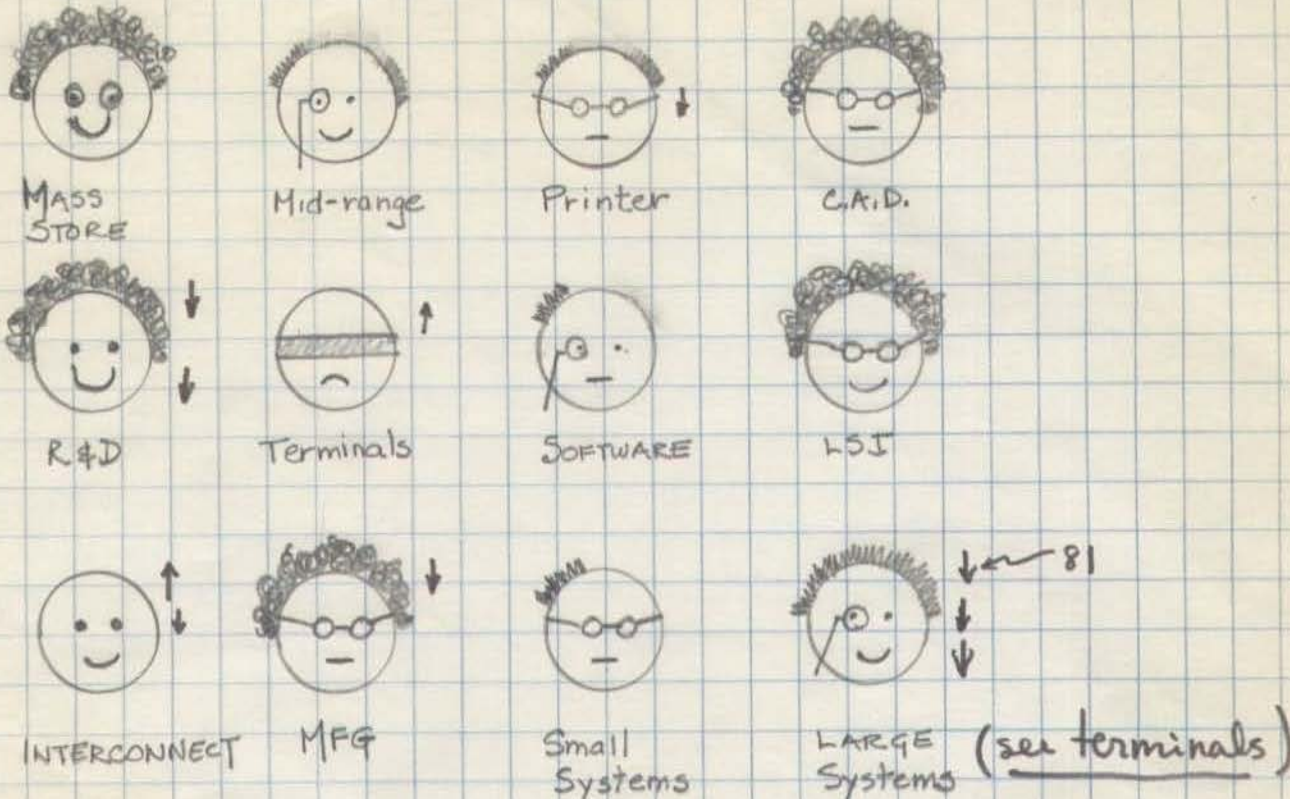
4.Proposals to build must explicitly demonstrate that:
   a.project will result in a quantum jump in technology or
   b.needed to introduce (or confine) a vital technology to DEC or
   c.present or developing vendors are unable to supply demands of ON-GOING high production item.

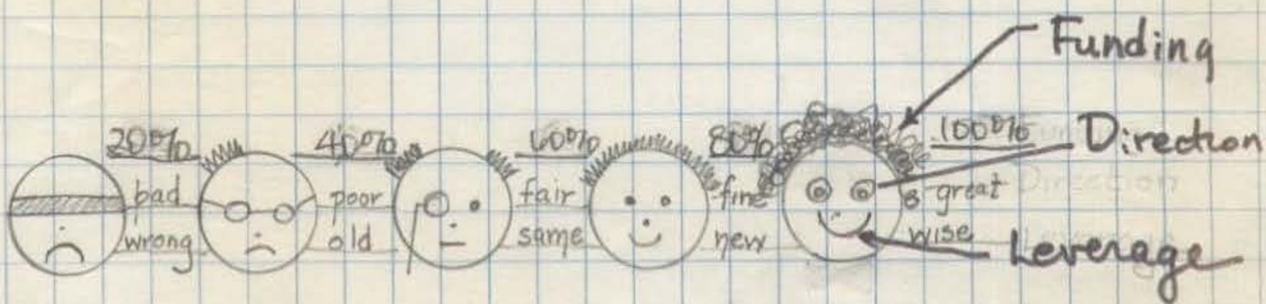
5.All proposals to build should address and be screened by at least the following criteria:
   a.DEC's forecasted needs exceed the volume of at least the smallest economically viable vendor.
   b.DEC's engineering resources to accomplish task is at least comparable to vendor.
   c.Incremental NOR/employee will be above the corporate average for the effort. [We should strive to increase "PRODUCTIVITY".]
   d.Hardware products can be sold through the Components Group. [The product is inherently good enough to stand on its own.]
   e.ROI analysis of not only the results of pursuing the project but the corresponding results when using the vendors part.
   f.Level-of-integration of the project. [We should tend to increase level-of-integration-focus on MAKING what we sell--NOT what we BUY.]
   g.The resulting incremental NOR to development cost ratio compare with Corporate NOR to total engineering ratio budgets. [Won't become an engineering sink.]

6.We must have a "buy out" advocate to test analysis (in Manufacturing, Purchasing, and Engineering?).

7.Proposals to "make" must be explicit with respect to the level-of-integration covered (i.e., which parts). "Making" is not a carte blanche licensing to make everything.

Are we spending lots of money ? (NO)
in low payoff Advanced-Dev. Projects ? (NO)





1980 ADVANCED DEVELOPMENT
(we're thin in 80 & 81).

5/3/81.

April 1981

G Bell.

Engineering Strategy Overview

Preliminary

Company Confidential

Market <-> development can be a closed ...

- See Hennessy's comments
- Written description of what the transition means.
  people, skills, work, customers,
- Big advantage of strategy: responsiveness to possible I. style transitions. also weakness — too much!
- integrate WP/DP
- Heuristics: The competition metrics are ~~both inside~~ fundamentally outside. While focusing on how ~~competitive~~ the Q & U compare we got our ass whipped!

McNam

- It pays to be excellent (McNamara) cost, perf, total life cycle cost, productivity, features
- old products never die unless they are replaced by form, fit & function by another
- The idea that a new product will replace two old products A and B is totally without (all) basis. Gets you in 3 products.!
- LSI coupled with compat. is ~~a powerful~~ an extremely potent comb.

Gordon Bell #1
ML12-1/A51

PRELIMINARY

ENGINEERING

STRATEGY

OVERVIEW

April 1981
First Draft

PRELIMINARY ENGINEER STRATEGY OVERVIEW

TABLE OF CONTENTS

GB2.S4.8

PREFACE

The "Engineering Strategy Overview" presents our vision of the technical direction of computing, an analysis of critical factors affecting DEC's future, and our strategy for allocating Engineering resources to maximize the Corporation's success.

The initial version of this document represents Engineering's viewpoint and recommendations. It will be presented to the Operations Committee for review on April 15, 1981, for critical decision making. The document will be updated to reflect the Operations Committee resource allocation and will then become the official statement of Engineering strategy. It will be distributed to the major functions within the Corporation to provide a clear view of the direction of our future products.

The document also will be distributed widely among the Line Managers and Consulting Engineers within Central Engineering. In addition, senior Engineering management will present the basic concepts at site meetings. It is felt that the best way to increase productivity and reduce hassle within Engineering is to ensure that everyone understands the strategy which must guide our actions.

CHAPTER I

THE PRODUCT STRATEGY
AND TRANSITIONING TO THE FIFTH GENERATION

THE PRODUCT STRATEGY OVERVIEW

THE FIFTH GENERATION
The transition to The Fifth Computer Generation is happening. All generations changes are painful and this one could be harmful unless we recognize and ease the transition. The Fifth Generation is based on: significant 16-bit microprocessors with large memory addressing; small, low cost, 5-10 megabyte mass storage; and communication using Ethernet-type interconnection. It is marked by Personal Computers that will evolve rapidly into Personal Computer Clusters. Clusters can be used as an alternative to our departmental timeshared minicomputers, just as the mini provided an alternative to the central mainframe.

Technology continues to provide 20% per year decline in the price of computing, permitting a wide range of computing styles from a $500 "PDP-11's in a book" to "Cray 1 power" VAXs for $250,000 in 1990. Competition will be fierce as 360/370's become available at minicomputer prices and the semicomputer companies sell what was formerly mainframe power processors for zero cost and start a new industry. Digital's Product Strategy with its homogeneous architecture is aimed at being a major force in this generation.

THE PRODUCT STRATEGY
The product strategy of a homogeneous architecture is simply:

- adopting a single VAX-11/VMS architecture;
- implementing a wide price range of products covering the computing styles of Personal (Individual) Computing, Timeshared Departmental Computing, and Central Computing;
- interconnecting these in a homogeneous network, including the formation of Personal Computer Clusters; and
- building critical and unique applications.

RATIONALE FOR THE STRATEGY
The basis for a winning strategy is:

- ability to build a homogeneous, network architecture which will greatly benefit the customers, by:

  - providing a wide range of price and styles for our varied customers, preserving their data, programming and training investments; and
  - allowing a user to compute, dynamically, anywhere across the compatible range without conversions;

- fewer systems to support across Digital, while covering a very wide price range, as processor cost becomes a smaller part of the total system cost;
- fewer systems also imply lower costs with higher quality and greater reliability by moving further down learning curves;
- a clear internal and external mission which both aids productivity and quality;
- product uniqueness and superiority against the emerging commodity-produced mainframes in our minicomputer price band and the semicomputer company "mainframes" fueling the emerging fifth generation computer system building boom; and
- support of our customer base and transition to this new computing style.

IMPLEMENTING THE STRATEGY

Implementation includes continuing to deliver significant 8- and 10/20-based products and building the necessary coexistence hardware and software to make the transition to VAX-11/VMS. The 11, using RSX-11/M will be the basis of Personal Computing until VAX-11/VMS is implementable as a low cost Personal Computer, PC, and Personal Computer Cluster, PCC. Homogeneity must be maintained via files, language, and interconnection standards enabling customers to preserve their data and program investment. RSX-11/M aids this transition because VAX-11/VMS provides a compatible environment. Immediately we must develop unique applications on VAX-11/VMS that cannot be built on competitive 360/370's and semicomputers.

This evolutionary strategy, as ratified two years ago, is the result of the 1975 decision to build VAX-11 together with the technology push and market pull to further distribute processing via Personal Computers and our own Local Area Network.

In the last two years since its inception, the strategy has proven increasingly attractive because no competition appears to have the same focussed vision, capacity and capability.

THE TRANSITIONS

TECHNOLOGY TRANSITION

Transition based on technology evolution is continuing at 20% cost decline per year as shown in the following figure, permitting an incredibly wide range of useful computing devices to be built. The generation period of seven years and the seven generations, 55 year period from 1945 to 2000, is described in the appendix on the fifth and sixth computer technology generations. Economy of scale, also known as Grosch's law, does not hold today for any system or component except very large disks. However, there is diseconomy of scale for large systems primary memory.

From the generations graph, we can observe the following:

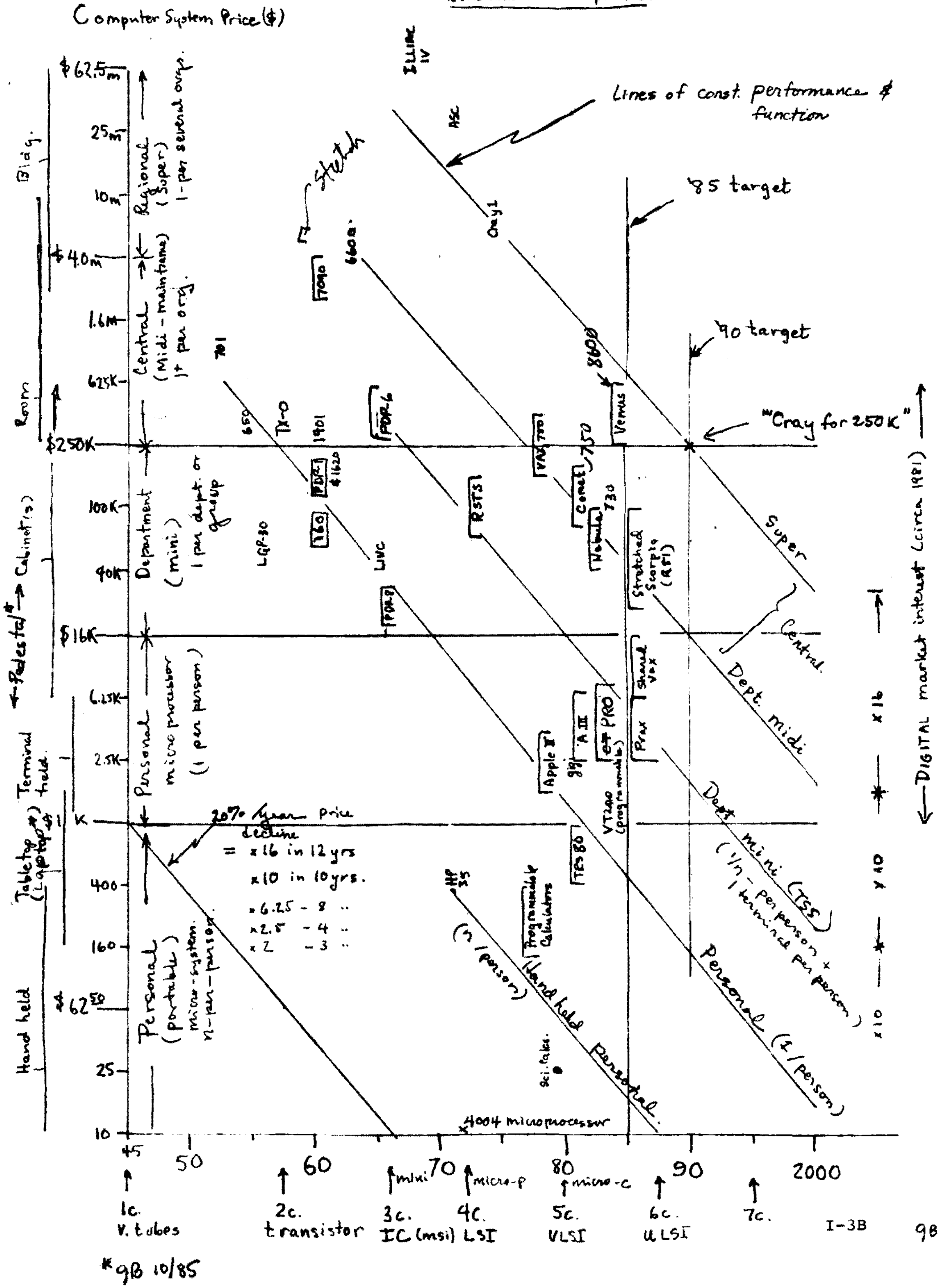
- there is a wider range of useful systems, and these will be appealing to our customers, us and others; For example, in 1985 we could be selling $1,000 computing terminals with the power of the original LINC, and $600K 10/20's.
- the wide range of useful systems will force all suppliers to be more competitive and selective as new suppliers enter on a point product basis and as the 370 becomes a commodity;
- IBM, Fujitsu, and others are likely to offer a 4341-2 class machine in our $40,000 to $100,000 minicomputer heartland;
- competitors, could be targetting the following (for 1985):

  - Cray 1 power, $625K (or in 1990 for $250K);
  - x3+ Comet power for $100K;
  - 780 power for $40K;
  - a sharable VAX (or big micro) in $6.25K to $16K range;
  - a personal VAX (or big micro) for under $6.25K;
  - a computing terminal with VT100 capability, and power of Apple II, or original LINC, for $1,000;
  - computers in $400 to $1,000 range;

- we have not provided aggressive enough products, because:
- the Q and U bus form factors have constrained system cost and size;
- the 19" rack and stack, palletable form factor together with poorly packaged components, has been retained; Packaging in other, lower cost form factors enabling cardboard box shipment and customer merge is essential.
- the terminal has not been used as a package; and

C O M P A N Y   C O N F I D E N T I A L

Fig. GC Computer System Price Versus Time for Various Benchmark Computers.



I-3B

GB 3/7/81

*GB 10/85

- point products have been insufficiently high quality, software supported, or cost-effective. Even $200 calculators are modular with mass storage, printer, modem and display options.

TRANSITION TO DISTRIBUTED COMPUTING BASED ON NI
The Network Interconnect, NI, based on Ethernet is the Local Area Network intercommunication medium for connecting all the computers within a building or set of buildings at a single location. Because it operates at 10 Mhz., it should have a long product life and be useful for interconnecting:

- departmental and central computers to each other;
- Personal Computers to form clusters;
- several thousand voice channels at 2 Khz;
- several hundred picture channels at 50 Khz;
- computer components together to form a computer; and
- functional server components in a distributed processing system. For DEC, we need to reduce the number of network possibilites that are a product of:

  - hardware systems;
  - the 12 operating systems we support; and
  - the desirable protocols including X.25, IBM, DECnet and other vendors.

  By using the server concept on a network wide, rather than a cluster basis, each system can be connected to NI, and then build specialized servers for the network nodes. We must build the following network-wide specialized servers:

  - concentrators for interconnecting dumb terminals and personal computers to all nodes of the network. This permits both concentration and switching to all nodes.
  - gateways to systems using other protocols; This would be done once and not in each system requiring communication with a particular system using a particular protocol.
  - repeaters and interfaces allowing various networks to communicate with one another;
  - central functional servers for the network, including printing;
  - real time front ends for interfacing real time control computers to the network.

TRANSITION TO PERSONAL COMPUTERS FROM MINIS AND MAINFRAMES
Personal computers are already beginning to affect the use of departmental level minicomputers and central mainframe

timeshared computers in several ways:

- direct, stand alone use;
- more terminal load can be put on a given computer when personal computers are attached to it using terminal emulation, thus lessening the need for more shared computing; (The leading edge university market shows this trend.)
- interconnected clusters of personal computers are a direct alternative and provide nearly all the advantages of timeshared computers.

The concept of Personal Computers interconnected via a Local Area Network Link, like NI, forming Personal Computer Clusters and using functional servers to handle communications, files, printing and interface to people is described in a following section. The Personal Computer has enormous market appeal because it:

- potentially covers the widest range of use on a cost per terminal basis, beginning with one user;
- is personal, non-sharable, and purchasable by an individual;
- has the best response time for what we think of as trivial computation tasks such as word processing; These highly interactive tasks require much computation and direct access to the screen for data manipulation.
- offers every capability that a dumb terminal has, including installability, yet is only slightly more expensive;
- can carry out many of the tasks that timesharing systems do; and
- can operate within a cluster to have virtually all the important attributes of a large, timeshared system.

We must get the necessary architecture for the clustered systems. Many systems have been built using this distributed server structure. Experimental systems are being planned or built by the Office Group, Laboratory Data Products, Small Systems, VMS, Research, the Computing Terminal base system and DECnet/ Distributed Systems. These systems have to have a standard interface for this level of communication so they can communicate with one another.

TRANSITION FROM CONVENTIONAL RACK AND STACK 16-BIT COMPUTERS
The transition from our current 16-bit rack and stack and Q and Unibus systems business must be made. They are not declining in price according to the technology and are being rendered uncompetitive. Also, every application involving a signficant amount of programming must evolve from the limits of the 16-bit address. The threats:

- 16-bit microprocessor cards and systems which have 22-bit memory address space and supplied by both semicomputer companies and their OEMS who are building competitive systems; UNIX and other approaches to building transportable systems are aimed at establishing hardware to be a commodity.
- board and box level systems that are oriented to modern special chip i/o as supplied by the semicomputer suppliers;
- Personal Computer and Clusters, as described above;
- 32-bit architectures, including the VAX architecture;
- better box-level form factors not possible with 19", FAT produced, Q- and Unibus systems; Systems must be shipped in cardboard boxes, integrated by the customer, and when broken, self-diagnosing with customer replaceability.

TRANSITION FROM TERMINALS TO COMPUTING TERMINALS
The major transition for terminals is semantic. That is, just what is a terminal? It is clear that there will be no dumb or fixed function terminals by 1985. Every future terminal we introduce must be a computing terminal. Terminals must change in the following ways:

- larger Personal Computers are an alternative to our conventional, dumb terminals;
- all terminals introduced beginning in FY83 must be customer programmable with at least firmware ROMs and RAM buffers;
- the interconnection, whether it be U. S. or European Modem, NI, or IBM emulator, must be built into the terminal;
- decreasing memory cost will offer fully programmable screens, which in turn will automatically provide graphics; and
- higher resolution, full-page and color displays.

TRANSITION TO SOFTWARE FOR END USE VERSUS PROGRAMMER TOOLS
Although we will continue to supply software for the systems and applications programmers, we are beginning to supply tools for generic applications such as word processing. Using a computer in the office is contrary to our successful past, where we could use ourselves as the model user. Fortunately, we have offices within DEC, and must use them as a laboratory for building effective products. Specifically, we can identify these needs:

- direct use in the office, including providing the ability for OEMs, office managers, organization, and the individuals to tailor their systems;

- better human engineering at the screen and in documentation; Documents and help should be built-in.
- all products must be modifiable for use with any natural language; We sell products in all countries, and these products must operate in the mother tongue.
- applications building tools that professionals who understand various businesses can use to write applications programs for particular professional and commercial environments.

TRANSITION IN HARDWARE DESIGN SKILLS

The transition in the way we design systems is quite radical, especially as we move into the sixth generation where our current mid range systems are placed on a single chip. At this time, we would expect constant cost mid range systems to be able to store and process voice and images and to be able to communicate with everyone at their own level. The immediate transitions for system designers includes:

- standardization and use of general purpose controllers and processors for conventional controllers; We are not using enough standard VLSI! This also implies that virtually all options are programmed in ROM (firmware), with programs that are fundamentally real time operating system applications. We are failing to recognize and manage this transition at this time.
- use of gate arrays and other LSI to lower cost of all jelly bean and non-processor logic; This requires a significant investment in CAD and designer training. Although this design approach will be used throughout the next generation, it is interim until VLSI design is understood.
- VLSI design, where processors and controllers are placed on a single chip; Currently this is so expensive, that we are not developing chips or design skills outside the Semiconductor Engineering Group to any extent. We need tools so that a basic design can be done in the same time as a PC Board layout; furthermore the PC Board layout and acquisition time must be reduced to one week. We must engage in more VLSI design as a means of cost reduction in some of our high cost peripherals (eg. the electronics constitute 1/2 the cost of the R80!).
- identification of either general purpose or special purpose computers based on VLSI for building the non-processor portion of systems to drastically reduce system cost. Processor design has been the past focus, and now we must optimize the total system cost, including maintenance (life cycle cost) and use.

PERSONAL COMPUTER CLUSTERS, PCC, ARE AN ALTERNATIVE TO TIMESHARED COMPUTERS WITH DUMB TERMINALS

We must establish the 11 as the Personal Computer standard, and build Personal Computer Clusters and Networks compatible with VAX files, and languages. We must introduce a VAX Personal Computer by 1985.

The opening statement of the August 1979 CMU Research Proposal for Personal Computers was "Timesharing is dead, to be replaced by networks of Personal Computers in the 80's". Research groups have built and are building Personal Computer Networks (PCNs) using PCs costing $20K-50K and interconnected by high speed links like the Ethernet. Xerox Research PARC, the developer of the "distributed server" architecture, is the archetype of this environment with several hundred Alto personal computers and service facilities (e.g. File Servers, Printer Servers, Network Server for interconnection to outside computers, and a Tenex Computation and File Server) interconnected over 3 Ethernet segments of several kilometers. Apollo has just introduced a PCN, based on a ring structure and using the M68000, aimed at the technical professional. Three Rivers are delivering PERQs to the CS community and Convergent Technology has announced a clustered, professional workstation. The Datapoint computer system is built using the "distributed server" structure. Apple is likely to introduce Apple-net in 1981 to interconnect their PC's, forming Personal Computer Networks (PCN's). Wang and other WPSs are organized around a co-axial ring, using file and printer servers, and distributing the processing in the terminal computer, forming a limited, single cluster (PCC). Semiconductor companies have again lowered the barrier for entry into the lower part of the computer market.

The PC has evolved from a tiny computer with a serial link to a dumb terminal (glass teletype). New PC's must have the ability to save and restore a complete screen, as the screen is mapped into the processor's primary memory, and to be able to use a screen to help the user more, in a similar fashion to the TV games. This very high speed communication will dictate a whole different Operating System philosophy for screen management. Equally important is "distributing" the operating system to clusters of PC's using the emerging high speed links such as Ethernet.

COMPUTERS ARE A NEW COMPUTER GENERATION
Personal Computers, Personal Computer Clusters, and Personal Computer Networks all form alternatives to our small, medium

and large timesharing systems (TSS's) for various reasons and, therefore, we have no choice of ignoring them! The figure shows a guess at how the computing style (batch, shared, RJE, personal, PCC, PCN) has evolved and will evolve from 1950-1990.

Given that a terminal has video, keyboard, power supply, control logic in the form of a microprocessor, a package constrained by the video and keyboard, it is only slightly more expensive to increment the primary memory and add a secondary memory to get a complete computer capable of standing alone and acting as a terminal emulator.

As an example of a terminal evolving into a PC, GIGI has a ROM which gives it Microsoft BASIC capability. Although we provide no secondary memory for programs, our customers probably will. Therefore, the forces to make every terminal evolve into a personal computer are:

- constant overhead of the terminal;
- high cost of people sitting at the terminals (e.g. $20K- 150K/year) relative to the terminal;
- lower primary memory cost;
- need for much more processing at the terminal and high bandwidth between the terminal and computer to get more productivity from expensive people;
- the introduction of the small floppy and now
- the small Winchester that can be packaged in the terminal.

Given that we sell a lot of dumb terminals, it is important for us to evolve them this way.

Tasks like editing require a great amount of computing power and very fast interrupt response time. It should also be noted that this kind of response is virtually impossible to deliver in very large, shared systems and gets even worse in very large computers. The issue is really latency versus throughput. There is some evidence to show that the cache miss rate goes up as the square of the processor speed. Also, the access time of large disks is not improving as rapidly as processing speed.

Just as there have been forces to establish the PC as an alternative to the dumb terminal using a terminal emulator program, the forces will continue to replace all the functions that the timeshared system provides by clustering the PC's and by having shared facilities using Ethernet. As we simply cluster the PCs, communication and file access among the machines is provided as long as all the computers are ALL turned on. This requirement leads back to asking for some shared facilities in addition to the communications link. Sharing occurs for two reasons: it is drastically cheaper or that it is necessary for communications. High performance or high quality printers, communications facilities, and large filing systems are examples of economic sharing; a filing system and communications link are examples of communications sharing. With sharing, there's also the need for privacy and higher overall reliability for shared parts.

EVOLUTION FROM TSS TO PC CLUSTERS AND NETWORKS
DEC developed Timesharing Systems (TSSs) so that everyone could "apparently" have their own computer which could be operated in an interactive, not batch fashion. We also built single user minis so everyone could have their own computer (e.g., LINC) as the first truly interactive, personal computers ... and then we put timesharing on the larger minis (e.g. TSS8, evolving to RSTS) to get the cost per terminal down. This era covers 1965 to 1980. 1980 to 1990 is likely to be a transition from the shared system to powerful PC's!

In 1977, with good microprocessors, low cost RAM, and small floppies, the Personal Computer (PC) entered the scene as an alternative to some TSS. By simply adding a terminal emulation program, a PC could operate as a dumb terminal (with some nice file access capability like the old Teletype ASR 33) and still be connected to a TSS. YET THE COST IS NOT MUCH MORE THAN A DUMB TERMINAL. WPS78 is a good example of a PC doing word processing (WP) and behaving as a terminal emulator. PC's that only stand alone and use terminal emulators will be a short lived phenomenon, covering only 1975 to 1985, because there is pressure to have PC Networks in order to minimize and localize shared facilities. This is analogous to the growth limits that departmental minis have placed on central mainframes. However, it is possible that PC's with terminal emulators could strengthen central mainframe computing and decrease departmental minis. PC's with terminal emulation and access to central systems will have wide scale home use!

PC Networks will form from economic pressure and sharing needs. Local area networks like Ethernet permit their formation. Thus, by proper design it appears that one can cover a much wider dynamic product range using this approach as compared to our TSS approach. Figure Evolve shows the evolution from Timesharing Systems to Personal Computers with dumb terminal emulation programs to PC Clusters and finally to networks of clusters PC Networks.

A TSS is composed of components that in principle can be broken apart and assigned to individual computers when forming a distributed PC cluster. A cluster is organized around the "distributed server" concept, where one or more computers reside on distinct processors and communicate with one another using a message passing mechanism via the fast, serial local area network link. The components include: the local area network link, the basic "person server", file service, print service (print queue), communications and network service. The scheduling and accounting programs, and of course, the jobs that exist for each person are distributed on the "person server" machines (i.e. the PCs ... which indeed must be capable of operating standalone!).

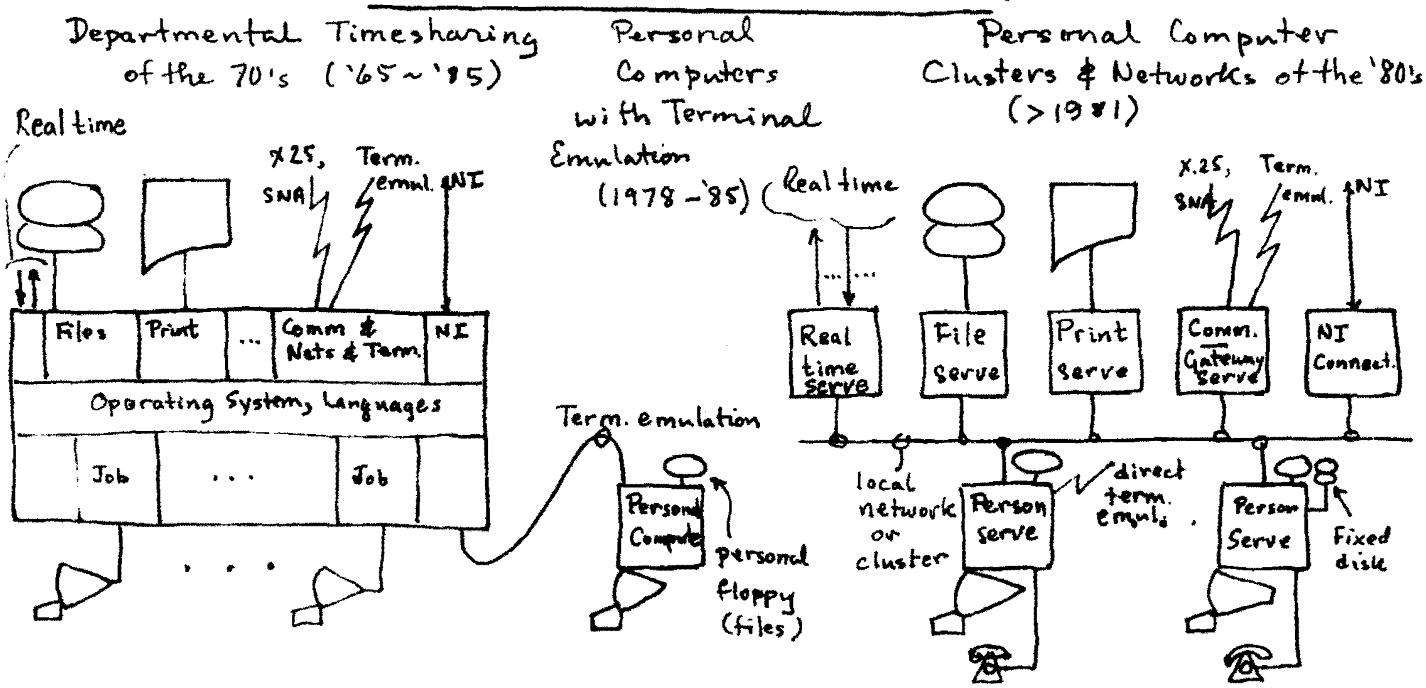
Each of the system structures provide alternative capabilities as shown in the following table.

Table of What Timeshared, PC's, PC Cluster an PC Networks Provide

~~TABLE: WHAT TSS, PC'S AND PC CLUSTERS~~ OR NETWORKS PROVIDE

What	Timeshared System	Personal Computer	PC Cluster/ Networks
processing	highest peak	lo-med, guaranteed	= PC
programs size	very high peak	small to medium	= PC
filing	large	small, guaranteed (+ off line)	= PC and TSS
communication	network	term. emulation	= PC and TSS
CRT	slow response "glass Teletype"	fast response, screen oriented	= PC = PC
cost	fixed, can go to lowest$/terminal	lowest entry	f(no. of PCs)
secure	shared, public access	totally private	contained/TSS
pros	explicit costs shared programs big jobs	low entry cost "owned" by indiv. security SW publishing = low cost	ability to expand shared facilities better match to org. structure
cons	shared poor response for terminals higher entry security	limited capability, but increasing	limited proc/prog. shared facilities
heterogeneity	one system homogeneous	n computers	one system / Can be heterogeneous.

EVOLUTION FROM TIMESHARING



Estimated (G. Bell) Percentage (in # terminals) of Computer Use
Versus time (1950–1990)

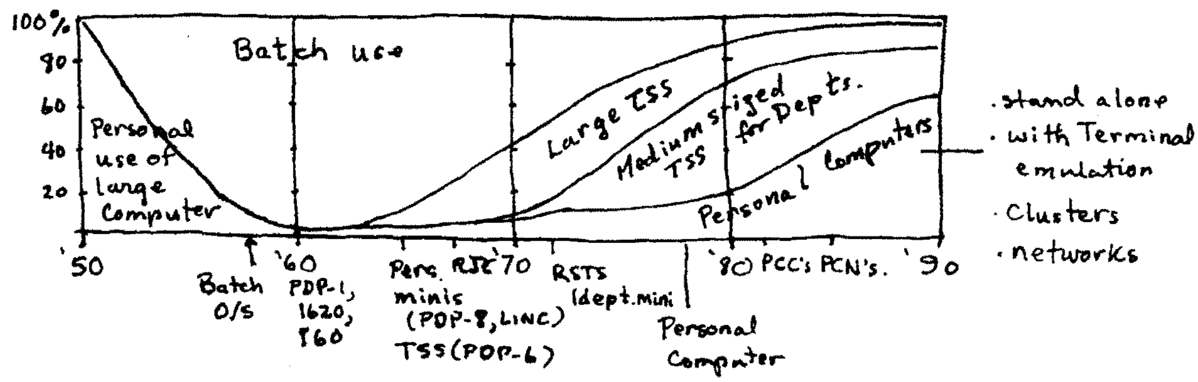


Fig. PC Evolution of COMPUTER Use 1950 – 1990 gB 3/8/81

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THE PRODUCT STRATEGY

Provide a set of homogeneous distributed computing system products so a user can interface, store information and compute, without re-programming or extra work from the following computer system sizes and styles:

- as a single user, personal (micro) computer (PC) within a terminal, and evolving to PC Clusters and PC Networks;
- at a small, local shared, departmental (mini) computer system, and
- via a cluster of large central computer(s);
- with interfacing to other systems for real time processing; and
- all interconnected via NI.

VAX/VMS AND NETWORK BASE ENVIRONMENT
Achieve a single VAX-11/VMS, distributed computing architecture by 1985 (as measured by revenue) through:

- homogeneous distributed computing with varying computing styles including high availability and measured ease (economy) of use;
- building new 11 hardware to fill the product space below VAX; i.e. building a significant PC on the 11 with VAX-compatible files and languages so that user software investment is preserved when the ultimate transition from the 11 to VAX occurs;
- having a clear physical bus structure evolution and transition plan;
- and developing VAX, Personal 11, RSTS, M and M+ software for 11-VAX migration and 11 base protection.

Provide 10/20 systems that will co-exist with VAX/VMS through:

- building hardware that runs current 10 and 20 software;
- building VMS co-existence aids and using common components; and
- making market support and DEC-standard language enhancements.

Build and support the PDP-8 for WPS and small business applications until we get PC-11. Invest in application software that will be compatible with the strategy.

Ethernet (NI), which we call DECnet IV, is the backbone of our distributed processing. Aggressively breadboard; then develop it for gateways and concentrators. This forms the basis for the "server" model of computing for the network.

Provide essential IBM network interfaces and help set International standards. These include: Open-systems Interface, and page standards for text and mail.

APPLICATIONS
Provide general applications-level products that run on VMS and if possible layered on RSTS, M, 10 and 20, as a base for direct use, OEM and user programming including (in order):

- word processing, electronic mail, user typesetting and profession-based CRT-oriented calculators for the office and for professions;
- transaction processing, forms management, and data base query;
- management tools for various sized businesses; and
- general libraries, such as PERT, simulation, etc. aimed at many professions that cross many institutions (industry, government, education, home).

Provide specific profession (e.g., electronic engineering, actuarial statistician), industry (e.g., drug distributor, heavy manufacturer) and commercial products as needed by the Product Lines. Select from the wide range of possible languages a small subset for our own applications programming.

USER LEVEL COMPATIBILITY
Define, and make clear statements internally and to our users about programming for DEC distributed computing environment compatibility. Tighten DEC user interface standards for editors, forms management, application terminals, files and data bases, command languages, language dialects (e.g., BASIC), and applications languages.

DEC standards must be industry standards to get the software industry's maximum support.

HARDWARE COMPONENTS

Interconnection
Interconnection hierarchy with software compatibility:

- 0.3-19.2 Khz point to point communication line compatible for direct, dumb terminal;
- 10Mhz NI for interconnection at a site and the backbone of the distributed processing structure;
- 80 Mhz CI for interconnecting Hydra and 10/20/VAX Clusters (in a room).

Computer Systems
Thin out our basic computers by 11 to VAX transition and by

positioning CPU and Mass Storage systems (including PC's) to be a separated at least a factor of 2.5 apart in the price bands. A low cost, high performance processor either alone or in a multiprocessor configuration should cover a system range of up to 3 bands when combined with the appropriate mass storage configurations.

Memories
Cover the wide range of needs:

- solid state modules for low end software in terminals and PC;
- range of components for Personal Computers;
- removeable and low cost disk (Aztec, small Winchesters) for entry-level shared system;
- hi-volume, mid- and hi-end disks in (R80/R81) with (backup);
- high performance controllers;
  and HSC-50 controller for Hydra (evolving to file and data base service).

Computing Terminals
Terminals for everyone (in priority):

- office environment for quality printing, electronic mail, evolving ASAP for needs (and uniqueness); and
- professional using graphics (and/or color) evolving to handle images with target application software,
- low cost (dumb) but with ROM programmability for special use

NI and NI-Servers for Both Shared and PC Clusters
The NI and Personal Computers permit the evolution of two kinds of structures: Distributed Processing with functional servers for our central and departmental TSS's; and the basis of PC clusters (in order):

- intercommunication among all personal and shared systems;
- real time service for process and experimental equipment i/o;
- communications concentrators for dumb terminal interconnection to predominantly central sites;
- communications gateways to IBM, X25, and non-DEC NI nodes, all levels;
- file service at central and departmental sites for all levels, but predominantly PC's; and
- printer service at central and departmental sites for all levels, including PC's.

Specific Personal Computer Products

- aggressively build PC-11 for three environments:
    - support our past, conventional O/S's on the PC-11 hardware;
    - as part of the DEC architecture which starts standalone and evolves to a cluster; this system is compatible with a VAX subset for files and programs and implies a different, lower level interface to be successful. THE Terminal interface must evolve beyond our "glass teletype" to include multiple, concurrent windows and processes.
- establish a VAX environment for PC's (including servers) to envelope the PC-11, PC-VAX (i.e., SUVAX) and PC-VAX (Scorpio)
- build, ship, and test a SUVAX to establish PC-VAX and PCC-VAX and to begin to acquire the applications that only VAX can support; and
- aggressively schedule PC-VAX with a 2.5K - 6.25K cost (system with high resolution scope and mass storage) by 1985

Timeline of Critical Technologies
The figure on the next page describes the availability of technology and various systems versus time.

|← PC's & PC Clusters now (5th gen.) →|← Voice and Pictures (6th generation)

80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90

Technology Needs Versus Time for FIFTH Generation

Memory
- ram: · 64K (2 Pages/chip) · 256K (8 Pages) · 1 Mega bit (32 pages)
- rom.
- Secondary: · T/E ? low cost take-away memory. · 5~10 Mbyte Wini → evolution · Aztec · R81 · HSC50.
- Videodisk: rom ram ?

PC's / C's.
- Chips/Syst.: · C · T · N · Saras · J · Venus · Scorpio · Nautilus. (Venus II – Gray for 250K)
- PC's: · CT120 · Portable II · PVAX · capabilities to vax. ← vectors to VAX arch.
- multi-C: · Hydra. · HSC50 · Hq. smP-VAX · TMR VAX. · Self repairing C's. · Self diagnosis & user install/repair.

Links
- · NI · first NI chip · CATK compat. NI · Encryption required.
- · 1 chip modems.
- · Combined voice/data for CT.

Servers ?

Transducers
- VT200
- · fullpage (text/graphics) images. & objects to video output
- input · OCR · low cost video input
- hardcopy LA24 Copier/printer H/S print.
- Voice · Voice Commands · NI voice · EMS Voicegrams. Continuous Speech recognition
- Automata. "Seeing" robots.

Programs
- · 3 level Homogenet. · Secure VMS. Users, OEMS, acquire SW.
- · CT120 ADA avail. · Begin "cottage" industry of ADA modules. } SW publishing Industry (std. proced. lang.)
- · Visicalc. · Visicalc II. · Visicalc III
- · Parameterized SW.
- · Dawn.
- · CT120 PC SW } Users Do applications (non-procedural language)
- · OAS · EMS · Graphics/text. · Voice WPS.
- Computers for Prof's. ≡ Knowledge Engineering
- · ability to encode knowledge automatically with non-computer professional.
- Knowledged engineered systems · Macsyma, Dendril, XCON. · BVAX

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THE FIFTH AND SIXTH COMPUTER TECHNOLOGY GENERATIONS

A computer generation is identified by four concurrent factors:

- the technology on which the machine (hardware and software) is based;
- the emergence of the machine itself;
- the intended need; and
- the actual use (market)...which may turn out to be a new machine (software) defined by users

The Table of Computing Generations lists various landmarks for these factors in both the future and past generations including the three pre-computing generations. Technology generations are now roughly seven years. These generations are driven mainly by semiconductors which evolve exponentially at yearly density factors of 1.6 - 2.0 and are used for processors and primary memory. Secondary memory in the form of magnetic disks evolve nearly as rapidly with factor changes of 1.4 per year. The seventh generation is fuzzy, so for our purposes, we can look at the next two generations 1980-87 and 1987- 1995.

The seven year period between generations will continue on into the future, based primarily on technology, and machines because:

1. Historically benchmark machines and/or computing styles have emerged each seven or eight years.

   The personal computer has emerged in the late fourth generation. With local area network communication, clusters and networks of PCs with specialized function servers (e.g. files, computation, communications) will create a drastically new, alternative distributed computer structure forming the fifth generation.

2. Seven years is roughly the time to get a factor of 100 in semiconductor memory density using Moore's law. (Semiconductor memories double in size every year; the number of bits/die = $2^{(t-1962)}$ for experimental circuits. Add 3 years for the circuit in production.) A more conservative model by Faggin has memory density growing at 1.6/year, thus a factor of 100 would take 10 years. The continued increase in density (at least at 1.6x) looks assured.

3. Seven years is roughly two product design and use generations for small systems. For higher cost machines (minis...super), the product periodicity is roughly seven years.

4. Every ten years drastically new use (and then product) segments occur, having at least a factor of ten lower cost. We assume the real cost reductions will continue at this 20%/year, independent of system size. (Faggin's projection is a factor of 10 cost reduction in 8 years or 25%/year. My 1975 model projected from 1972 used 21% and is given in the following table below, even though it might be appropriate to use a more rapidly decreasing rate (e.g., 25%).

TABLE OF COMPUTING GENERATIONS, WITH NEED, USE AND STRUCTURES

GENERATION	HIGH LEVEL NEED	SPECIFIC USE	COMPUTER STRUCTURE
Electro-mechanical 2 p.c. 1890	Mass production & census	Census & modern accounting	Comptometer, Electric calculator, Hollerith & accounting machines
Electronic (thermonic) 1 p.c. 1930	Power, highway & communication grids	Engineering calculations & cryptography	Network analyzer, Mark I, Bell Labs calculators, ENIAC, Collosus.
Electronic (magnetic) 1 c. 1945	Defense	War-machine control via tables & real time	EDVAC, EDSAC, IAS, Whirlwind, LGP30, IBM 650, 701, 709, UNIVAC.
Transistors 2 c. 1958	Space & science	Air defense & traffic control; Engineering & science education	TX-0, IBM 7090 Atlas, Stretch
Integrated Circuits 3 c. 1966	Transport flow control & welfare	Process control & social accounting, minis	PDP-8, B5000, PDP-6, IBM 360, CDC 6600
LSI 4 c. 1972	Economic models & r.t. control	Interactive computing, computers for logic	Intel 4004, 8008, PDP-11 (RSTS), Cray 1
VLSI 5 c. 1980	Productivity	Office (& home) personal computing	Personal Computer Clusters; VAX Homogenets; general purpose robots
ULSI 6 c. ~1987	Information & program overload, energy	Knowledge-based systems and video processing	Integration into standard communications
Electro-optical 7 c. ~1995	Arts, leisure, food & energy crisis.	Travel substitute & environmental management.	Global communication of video

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G Bell System Price Model (3/75)

System price ($) per byte of main memory

$$= 3 \times 5 \times 8 \times .005 \times .79^{t-1972} \times \text{no. of bytes}$$

$$= .6 \times .79^{t-1972} \times \text{no. of bytes}$$

where

3 is markup (roughly)
5 is fact that about 1/5 of system is primary memory
8 is 8 bits/byte
.005 is cost of a bit in 1972
.79 is 21% price decline per year for memory
1972 is base year

Some system prices at various time using the GB 3/75 model:

Bytes	Use	1978	1980	1982	Example
1		.146	.091	.057	
8K	Dedicated fixed	1.2K	745	467	TRS
65K (Qbus limit)	1 user interactive	9.6K	5.9K	3.7K	Apple II/III
256K (Ubus limit)	n user, 1 applic.	28.3K	23.9K	14.9K	11/23
1M	Small, gp. t/s	153K	95.4K	59.8K	Comet
2M (11/70 bus limit)	Mid, gp. t/s	306K	190.8K	119.5K	VAX 780
8M	Large, gp. t/s	1,225K		763K	478K

5. Breadboard structures have emerged in the early part of this fifth generation that can be mass produced to fuel the sixth generation. My guess is that this will take on the form of significantly better I/O, storage, and processing of both voice and 2-d images.

6. There is implicit faith that there's an infinite market. This is clearly substantiated using the five year market data projections. A paper, "Limits of Distributed Processing" describes our computing structure environment together with the factors that may limit computing. None of the following factors look insurmountable for continued exponential change.

. technology
. VLSI design and new ideas for designs

C O M P A N Y   C O N F I D E N T I A L

- too many standards, especially in communications/networks
- algorithms
- ability to define and supply useful systems
- lack of applications programs (programmers)...perhaps the most serious
- ability for users to get work from systems

A fifth generation computer, can be fabricated on a very large scale integrated circuit (VLSI). Lower cost and increased use disperses computers in a manner analogous to the ubiquitous fractional horsepower motor. Distributed processing to interconnect dispersed computers is essential in order to avoid overloading people with information transmission and translation tasks.

The factors that affect and limit distributed processing are: physical technology and design complexity, ideas for new computer structures, basic tools to build applications, networking and other standards, useful applications, algorithms, and the human interface to the end user. A hierarchical, interconnecting model for distributing processing is based on established central and group level mini-computers, and evolving, personal computers.

DISTRIBUTED PROCESSING

Distributed processing matches computer systems to information processing needs (i.e. processing, memory, switching, transmission and transduction needs) on a geographical or organizational basis, and interconnects individual computers to form a single, integrated network so that related programs can share and transmit data among the computer nodes. The objectives are:

- to allow either local autonomy or central control of the various distributed parts;
- to provide an evolving open-ended system so that the development and installation of the parts can proceed in a quasi-independent fashion;
- to allow purchase and installation of hardware, taking advantage of timely, reduced hardware cost; and
- to build on and communicate with central systems, fully dispersed group-level mini-computer systems, and emerging personal computers.

Distributed processing is inherently hierarchical based on the principles that govern human organizational structures. In an organization, computers supplement their human, information processing counter-parts. As computers become better matched to people and organizations, and as people and organizations become more familiar with computers, an individual can interact directly with at least one computer and indirectly with group-level computers serving various functions of the organizational hierarchy. The opportunity of more egalitarian access to data provided by distributed processing may led to a change of the large organization from hierarchical to wider, functional matrix structures.

Large organizations need to interconnect the hierarchy of computers for:

- communication among computer with dumb and intelligent terminals using large, central computers;
- organization of central, group and individual sites; a functional activity such as word processing or order processing; and
- a specialized computer-based function such as archiving, typesetting, message switching, and electronic mail.

FORCES CREATING DISTRIBUTED PROCESSING
Rapid evolution of semiconductor and magnetic recording technologies have forced computers improvements along paths of:

1. constant cost, with increased performance and productivity for evolutionary use;
2. reduced cost, with constant performance permitting new uses commensurate with the lower cost; and
3. higher cost and performance structures permitting radically new applications.

Costs for nearly all other forms of information processing are because they are labor intensive. Traditional storage, processing, and transmission in libraries and postal systems are increasingly soaring. Simple word processing computers that replace typewriters save the time-consuming process of correcting errors. When groups associated with information processing start using computers a positive feedback, learning curve effect begins further increasing computer markets and uses, and lowering costs.

The industry groups supplying these products and services include:

- computers - mainframe, minicomputers, personal computers and computer services;
- semiconductors - nearly all LSI components are either memory or a computer processor;
- communications - conventional voice and data, new packet networks and associated services;
- television and cable TV - stand-alone use with TV sets (e.g. games, home computers) and as an alternative to conventional communication;
- office equipment - typewriters, copiers, and mechanical office equipment are increasingly electronic; and
- control - gears, cams and levers, and mechanisms for

control will become electronic, limited only by transducers and sensors.

LIMITS AND PROBLEM AREAS OF DISTRIBUTED PROCESSING

Ultimately all information processing will be computer based. Presently the speed of the evolution is limited by two factors: technical solutions to distributed processing problems and user assimilation.

Physical Technology

Semiconductors and magnetic recording technology provide the basis for cost and performance improvements. Although, extrapolations too far into the future are generally dangerous, the following technological rates of change, based on the past ten years, will continue for at least five years:

TECHNOLOGY (PERFORMANCE)	YEARLY-RATE OF CHANGE FACTOR
semiconductor memory density	2.0
semiconductors, random logic	1.4-1.6
core memory density improvement	1.3
magnetic disk recording density	1.3-1.4
magnetic tape data-rate	1.25
magnetic tape density	1.2

TECHNOLOGY (COST)	YEARLY-RATE OF CHANGE FACTOR
memory price reduction	0.7
computer system cost reduction	0.8
crt terminal cost reduction	0.85
communication cost/bit transmitted reduction	0.9
packaging (cost/vol.) and power (cost/watt)	1.0
communication line cost <u>increase</u>	1.12
paper cost <u>increase</u>	1.12

Semiconductor technology, shared among several buyers groups, eg. consumer, communications, computers, has a faster rate of improvement than other technologies. Slower evolution has occurred in magnetic recording density because there is only one user, the computer industry. Widely used, well developed technologies, such as CRT's, previously improved for the mass television market are scarcely affected by their increasing use in computers. Costs of paper and communication lines increase with inflation.

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Physical transducers that sense temperature, pressure and control power flow are slow to evolve, limiting computer use in automotive applications. Even the most widely used computer equipment, such as keyboards, printing devices and communications devices, evolve slowly by comparison with semiconductors.

Complexity of Semiconductor Design
Gordon Moore of Intel, observed that the effort required to design semiconductors has doubled each 2-2/3 years since 1962, when a circuit only took 3 man months. 1979 circuits required 21 man years and 1982 circuits will take about 45 man years. While it is easy to conceive of organizing a team of 7 to complete a design in 3 years, the same time task by 15 people is difficult to imagine. Better management and design partitioning is required in order to avoid a drastic loss of productivity and quality that would increase the design effort even more. With one million circuits on a chip by 1982, new methodologies will be required to fully utilize VLSI's potential.

Because of the concern and numerous approaches being pursued, I am confident that it will only take another two semiconductor generations (six years) to solve the VLSI design complexity problem. Although we do not have a good measure of circuit complexity, a given circuit description is far less complex than the largest programs (e.g. a million bit, or 128 Kbyte program is not especially large).

Ideas About What to Build
New directions in computer structures are difficult to predict by simply looking at conventional machines. Current limiting factors point to needed innovations. Applications involving two dimensional signal processing for pictures appear to require a different processor design, and speech signal analysis requires vector processing. A general purpose processor could emerge from these alternatives for one-and two-dimensional arrays:

- arrays of conventional microprocessors;
- application specific, functional processors;
- bit array processors to operate directly on the array data structures, including arrays, or associative processing;
- processing associated with memory; and
- data flow architectures.

Basic Tools to Build Applications
Coupling knowledgeable user needs to machine development

produces more capable, yet harder to understand systems: a paradox in the attempt to build highly capable and easy to use systems. The popularity of the Bell Labs UNIX System is a testimony to a single, consistent, easy to use language, that is described in a small manual. The popularity of APL and BASIC systems can be similarly explained. Although one would expect that additional capabilities (memory) would make the user interface simpler, few good examples are known. The time to build a given application using the multitude of systems/databases/languages is highly variable, indicating a continued lack of understanding of the design process.

Network and Other Standards
Because standards are evolving, the current situation of distributed processing among countries and vendor systems is a disaster. International protocol standards provided by manufacturers (Internets) and by various common carriers for Packetnets which are called by the same name, are fundamentally different and incompatible. Many standards mean no standards.

We must get beyond the simple standards required for Packetnets and Internets to define protocols for passing high level messages, such as electronic mail, among computers. Office based applications, centered around text processing, electronic mail, user typesetting, office processing, and electronic filing, all require significant user level standards. Using only lower level communications protocol standards will cause a combinational explosion of high level protocol changing gateways. This leads to added overhead, extra development, delay, incompatibility, and often, misinterpretation of messages.

In the low priority area of intra-computer architecture, the U. S. Government has standardized on the existing defacto standard, the IBM Channel, as the means of interconnecting mass storage to computers. Unfortunately this act of standardization will limit change into newer systems architectures.

Useful Applications and Distributing Them
Decisions to use the major applications centered around office automation are very complex. Justifying an application generally requires an understanding of both computer systems (beyond that provided by manufacturers) and the organizational structure of individuals and group users. Although electronic mail seems right, measurements of increased productivity, decreased paper flow, better

decision-making, efficiency of communication, and the creation of excess communication are hard to make. To my knowledge, they don't exist.

Given that few measures exist to rationalize, simple stand-alone applications, justifying a distributed network becomes a work of art. Tools have only recently become available for a system manager or developer to distribute the database, processing, and intercommunications over several systems. In the specific case of distributed processing for electronic mail, the results are encouraging but a general solution has not yet emerged.

An underlying difficulty of building applications beyond the generic office automation described above exists because problems are solved by patch-work. Usually programmers with computer science (computer engineering) training and a representative of a particular discipline (eg. accounting, mechanical engineering) put a solution together to get something started. This results in sub-optimal designs. In order to use the computer as a component of systems they design, rather than as a simple tool for problem solving, computer science must take on a pure role, like physics, and each of the disciplines take the responsibility for training people and engineering the systems within its own discipline.

Algorithms

There are many cases of the adage: "It is better to work smarter rather than work harder". If always exponentially improving, technology will eventually permit solving a particular problem in a reasonable time, e.g. a 24 hour advanced weather forecast must be solved in less than 24 hours or an exponentially increasing machine population will be required. However, at a given time, algorithms limit when a problem can be solved and whether it is economically feasible.

Human Interface

The interface between the system and the final user is a barrier in the same way that a root system for building applications programs is a barrier to building applications. Adding more functions so that an application will perform better is generally accompanied by increased complexity requiring more documentation and training. The lack of standards at the user interface will limit getting the payoff inherent in a given system or set of systems, and may cause adverse user reaction. For example, word processing, electronic mail and user typesetting systems are all likely to have different syntax, semantics, manuals, training and procedures for dealing with the same text.

A DISTRIBUTED PROCESSING ENVIRONMENT
Proliferation of dispersed computing forces interconnection, hence distributed processing, so that human users don't have to become information carriers and translators between the different systems they use. Communication within and between organizations with common carrier networks is provided via an interconnected hierarchy.

Interconnecting the Components
The three types of computers in a given organization will be connected via high bandwidth links in what may appear to be a hierarchical structure. In addition, clusters may be connected on a fixed basis. The alternative interconnect possibilities are:

- ethernets or rings to interconnect all terminals and computers with specialized terminal concentrators;
- evolution of phone circuit switches using digital techniques for both voice and data;
- packetnet switching; and
- direct interconnection among the computers with routing through each computer.

Central Computers
The top most computers of the hierarchy will evolve from the current, highly central computation facilities. These machines store most of the data and do most of the computing in today's organizations. Given the difficulty of migrating files and work from these machines, the emphasis within the centers will be interconnection among the machines within each center, creating in the short run, even larger data bases. The tight interconnection among the central computers will also permit trade-offs among cost, reliability, performance, and evolving performance, for a given application or set of applications. In order to get the economy of scale required to support the large human organizations that attend central computers, their functions will have to be specialized (e.g. front ends for handling many communications lines, and back ending for databases and archiving).

Central computing facilities will continue to be operated by large staffs whose emphasis is on knowledge of the operating systems and getting work done using highly specialized facilities such as CODASYL Databases. The casual user will be dependent on the central systems through the applications. Cost will be high for everything except the storage of very large files, where hardware provides an economy of scale. Programming costs at the center have to be the highest, because the facilities are general purpose and applications are most remote from the ultimate user. The role of central facility will be to provide:

- communications among all the other computers within the organization including gateways between various computer and telecommunications vendors;
- archival file storage;
- unique, sharable facilities such as very high speed computers and printing devices;
- computational functions for the entire organization e.g. electronic mail;
- operation of historical programs and data bases; and
- relatively high cost computing by having to provide generality and service for the worst case.

Group Level Computers

Group level computers are based on the evolution of timeshared and real time minicomputers and cost roughly that of an additional person. Typically these machines support the single function of the group, (eg. order processing, engineering design and data base, laboratory data gathering and analysis, group word processing, single process control) running a single unattended program. Group level computers provide:

- relatively cost effective storage of the group data base;
- unique program(s) aligned with function of the group;
- relatively high performance processing; and
- cost-effective computing through sharing of a common function and specialization of work.

Personal Level Computers

Personal computers are emerging rapidly, and many believe that they will become the dominant form of computing. Since the only hardware technology for which economy of scale holds is mass storage, and given that all terminals already have embedded computers for control, it is easy to envision adding more primary memory and doing all the computation at the terminal instead of having computation done in any shared facility. A recent, Carnegie-Mellon University personal computer research proposal states:

> "The era of time-sharing is ending. Time-sharing evolved as a way to provide users with the power of a large interactive computer system at a time when such systems were too expensive to dedicate to a single

individual...Recent advances in hardware open up new possibilities...high resolution color graphics, 1 mip, 16 Kword, 1 Mbyte primary memory, 100 Mbyte secondary memory, special transducers,...We would expect that by the mid-1980's such systems could be priced around $10,000."

Personal computers provide:

- personal data bases and security;
- more, average computing power, with better response time than shared systems;
- needed processing for the computationally intensive tasks like editing, and speech i/o;
- a program creation environment; and
- relatively higher costs than group level computing, unless the task is very specific and well-matched to the system.

Although both the novice and experienced user relish the independence that the personal computer provides, communications and support by the other levels is equally necessary. Given that we are substantially far from such distributed systems, there are surely additional problems, limits, and opportunities that are yet to be forecast.

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CHAPTER II

ESSAYS ON THE CRITERIA FOR ALLOCATION OF ENGINEERING RESOURCES

OVERVIEW

Among the most critical decisions facing Digital each year is the allocation of our Engineering budget. What products and technologies should we invest in? Obviously,we want to maximize the long-term return to the Corporation. Chapter IV contains financial and marketing metrics which are helpful. We must produce the products needed to meet the Corporation's business goals. Moreover, we believe that DEC is in a "technology inspired" market so that the first test of a proposed investment should be its contribution to the basic strategy described in Chapter I.

Unfortunately, there is no algorithm for translating the broad strategic framework into specific investment tactics. We are forced to study a huge space of feasible choices that lie within our resources (i.e., budget, capital equipment, and talent pool). Then we apply various heuristics to select among the better options.

There are three closely related areas of choice:

- i) Products to build for the Company we want to be
- ii) Technologies to own (i.e., engineering and manufacturing processes)
- iii) Components to make vs buy

This Chapter contains several essays that provide some heuristics for selection in these areas:

1. <u>Heuristics for Building Great Products</u>
   by Gordon Bell

   The Group Vice-President for Engineering describes his rules for achieving winning products.

2. <u>Proposed Resource Allocation Criteria</u>
   by Bruce Delagi

   Another global "take" at identifying investments that support the strategy. Five critical factors are discussed -- vision, winning, partnership, quality, and productivity/responsiveness.

3. Technology Assessment and Recommendations
by Sam Fuller

The Engineering Technical Director presents an analysis of DEC's technology strengths and requirements. He offers recommendations on certain technology areas where we need to invest more.

4. DEC's Position in the VAN by Bruce Delagi

Computer products start with sand, fire, and water. They culminate in benefits delivered to end users. Different companies position themselves differently along the network of value-added contributors (VAN). This essay discusses a general philosphy of vertical integration and guidelines for selecting specific investment areas.

5. Buyout Philosophy/Process/Criteria
by Peter Van Roekens

Offers a recommended approach to the make versus buy decision as a part of the regular activities of our major programs.

6. Example of a "Make vs Buy" Analysis
by Gordon Bell and Grant Saviers

Actual "make versus buy" decisions can be very difficult. Two memos on high-end disk strategy provide a case study of the diversity of viewpoints and range of issues. Disks have a substantial leverage on profit since they represent the largest single component of systems cost. But if half the cost of current disks is electronics, perhaps semiconductor technology is more strategic since it impacts most of the components in a system.

7. Engineering Investment Sieve by Bruce Delagi

A short list of tests for the overall Engineering budget. It is a summary of issues considered at an Engineering Staff Strategy Woods.

This collection of essays presents a useful but incomplete set of criteria for the allocation of our Engineering resources. DEC is a large company with a diversity of on-going businesses. No single set of guidelines capture the complexity of the tradeoffs between our current business demands and our future opportunities. In the final analysis, the Engineering budget allocation must be a judgement call by our senior management. It has to be tested for consistency within itself and for consistency with our long-term Engineering strategy and our Corporate business plans.

HEURISTICS FOR BUILDING GREAT PRODUCTS

Products goodness is somewhat like pornography, it can't fully be described, but we're told people know it when they see it. There are lots of heuristics in the book, Computer Engineering. Since quality and competitive products must be our number one focus in these next generations, these heuristics are intended to help us. Only the five following need be attended to:

- a responsible, productive and creative engineering group;
- understanding product metrics (competitiveness);
- understanding the design constraints;
- knowing when to create new direction, when to evolve, and when to break with the past; and
- ability to get the product built and sold.

ENGINEERING GROUP
As a company whose management includes mostly engineers, we encourage engineering groups to form and design products. With this right of organizing, there are some responsibilities:

- basic notion of excellence and quality;
- understanding leadership who understands the product space and who has engineered successful products;
- having skills and disciplines required in the respective product area, eg. ergonometrics, acoustics, radiation, microprogramming, data bases, security, reliability;
- having skills on board to make the proposal so that we adhere to the cardinal rule of Digital, "He Who Proposes, Does"; Approving a plan, based on no implementers violates this.
- having open-ness, external reviews, clearly written descriptions of the product for inspection;
- as a corollary of being prepared with leadership and skills, we occasionally enter very new areas, requiring research and advanced development; Product commitment should not be made until fully operational breadboards exist.
- as a corollary, start up groups with no previous or poor previous track record, may need review.

PRODUCT METRICS
Since most of our products are evolutionary, engineering is responsible for knowing their product area, in terms of:

- major competitor cost, performance and functions

[illegible] Specification [illegible] entails the later stages of development; and
having a formal goals, constraints and design objectives document which ~~first~~ outlines the product dream and why it is likely to be met,
together with what they will introduce over the next 5 years;
- leading edge, innovative small company product introductions; and

DESIGN CONSTRAINTS
Design constraints such as acoustics, radiation, are basically useful because they limit choice of often trivial design decisions. We should meet the following design constraints, and if unacceptable, go about an orderly change:

- DEC Engineering Standards covering most physical structures and design practice for producibility; These assimilate the critical external standards such as VDE, and FCC as rapidly as possible.
- information processing and communications standards, such as Cobol, Codasyl, IEEE 488, EIA;
- information processing standards as determined by the key supplier, such as IBM SNA; For example, all eight versions of VISICALC we are implementing, should be compatible with external VISICALCs.
- the architecture of existing DEC products; For example, future editors should be compatible with the past editors, unless it can be shown experimentally that there is a significant (x2) benefit to change. These include:

  - ISPs of the 8, several 11's, 10/2, VAX-11, 8048, 8080 and are likely to include a 16-bit micro;
  - physical busses for interconnect; Fundamentally this insures that future products can evolve.
  - file, command language, human interface, calling sequence, screen/form management, keyboard, etc.

- we must not be undone by historically poor standards which constrain us to poor products; Currently, the 19" rack and the metal boxes we put in it, and then ship on pallets to our customers, act as constraints on building cost-effective PDP-11 Systems. This "mind set" standard is impeding our ability to produce products that meet the 20% cost decline. A target should be the shipment of systems in cardboard boxes which the customer assembles.
- ability to be implemented easily in any natural language, given that we are selling products in all countries.

WHEN TO CREATE A NEW PRODUCT DIRECTION OR WHEN TO EVOLVE THE OLD
Given all the constraints, can we ever create a new product,

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or is everything just an evolutionary extension of the past? Also do we know or care where product ideas come from? There are a whole set of places to look for products, but that's another set of heuristics, and the object of these heuristics is simplicity. The important aspect about product ideas is:

. Ideas must exist to have products!

It is hard to determine whether something is an evolution or just an extension. If you look at our family tree of products, like the one for our computing systems, and which every product group should have and maintain, the critically successful products all occur the second time around. Some examples: 6,KA,KI,KL,2080; Tops 10,Tenex,20; 5,8,8S,8I/L,8E/F/M; OS8-RT11; 11-20,40,34; RSX-A... M; TSS-8,RSTS; various versions of Fortran, Cobol and Basic all follow this; LA30,36,120; VT05,50/52,100; RK05,RL01/2.

Some heuristics in designing good products:

- all products whether they be revolutionary (we have yet to have any that are really in this category), or creating a new base, or evolutionary, should:
    - offer at least a factor of two in terms of cost-effectiveness over a current product; If we build unique products that do not compete with ourselves, then we will have funds to build really good products.
    - be based on an idea which will offer an attribute or set of attributes that no existing products have; For example, the goals and constraints for VAX included factor of two algorithm encoding and also offering ability to write a single program in multiple languages. VT100 got distinction by going to 132 columns and doing smooth scrolling.
    - build in generality, and extensibiility; We have not, historically been sufficently able to predict how applications will evolve, hence generality and extensibility allow us and our customers to deal with changing needs. We have built several dead end products with the intent of lower product cost, only to find that no one wants the particular collection of options. In reality, even the $200 calculators offer a familty of modular printer and mass storage options. For example, our 1-bit PDP-14 had no ability to do arithmetic or execute general purpose programs. As it began to be used, ad hoc extensions were installed to count, compare, etc.

and it evolved into a digital computer.

- build complete systems, not piece parts. The total system is what the user sees. A word processing system for example includes: mass storage, keyboard, tube, mdoems, cpu, documentation including how to unpack it, the programs, table (if there is one, if not then the method of using at the customer table), and shipping boxes.

- a new product base, such as a new ISP, physical interconnection specification, Operating System, approach to building Office Products must:

  - start a family tree for which we expect significant evolution to occur on, otherwise the investment for a point product is so short term and hence is likely to not payoff. In every case where we have successful evolutionary products, the successors are more successful than the first member of the family.

- a product family can evolve several ways as described on page 10 of Computer Engineering; The evolutionary paths are lower cost, and relatively constant performance; constant cost and higher performance; and higher cost and performance. In looking at our successful evolutions:

  - lower cost products can't get by without adding functionality too, as in the VT100;
  - constant cost, higher performance products are likely to be most useful, as economics of use are already established and a more powerful system such as the LA120 will allow more work to get done;

- a product evolution is likely to need termination after sucessive implementations, because new concepts in use have obsolesced its underlying structure. All structures decay with evolution, and the trick is to identify the last member of a family, such as the 132 column card, and then not build it. This holds for physical components, processors, terminals, mass storage, operating systems, languages and applications. Some of the signs of product obsolescence:

  - it has been extended at least once, and future extensions render it virtually uninteligible; (For example, PDP-8 was extended three times.)
  - significantly better products using other bases

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are available;

SELLING AND BUILDING THE PRODUCT
Buy in of the product can come at any time. However, if all the other rules are adhered to, there is no guarantee that it will be promoted, or that customers will find out about it and buy it. Some rules about selling it:

. it has to be producible and work; This, although seemingly trivial rule is often overlooked when explaining why a product is good or not.
. a business plan with orders and marketing plans from several marketing persons and groups needs to be in place; Just as it is unwise to depend on a single opinion in engineering for design and review, it is even more important that several different groups are intending to sell the product. Individual marketers are just as fallible as unchecked engineers.
. never build a product for a single customer, although a particular customer may be used as an archetype user. Predicating a product on a sale is the one sure way to fail!
. it should be done in a timely fashion according to the committed schedule, at the committed price and with the committed functions.

Now isn't it clear why building great products should be so easy?

Are there any heuristics that should be added? or are patently wrong? or need clarification?

Comments please!

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PROPOSED RESOURCES ALLOCATION CRITERIA (MEETING STRATEGIC THREATS)

VISION

We want to be known for a uniquely productive style of computing as described by the Product Strategy in Chapter I. This requires us to be primarily a company that understands and satisfies the information system needs of our users and their machines. This criterion calls for a return to a clearer image of what we stand for in computing. Our perceived edge in user productivity with respect to IBM is slipping.

The call is in distinction to becoming a company primarily engaged in high volume manufacture of component-commodity subsystems. The intent is supply high volume needs by providing a product offering that is sufficiently broad, deep and interrelated that it presents an especially attractive foundation for others to build on.

We hope that our customers will view us as particularly capable of managing complex technologies - providing results in particularly simple and effective packages. This will take the form of the industry's broadest range of comfortable, interconnected computing facilities.

Highly productive computing makes effective use of the human contribution. We want to be known for leadership in the human interface to information systems. This requires an understanding of cognitive as well as classical human factors. It implies an investment in speech and image processing in order to couple more effectively with the user.

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Leadership human interfaces are responsive, interactive human interfaces. To provide highly interactive systems, we need to support the cost-effective dispersal of processing to its point of use and use this processing power effectively in our terminals.

Increasing user productivity is measured against a given level of customer capital employed. Perceivably and measurable cost-effective user productivity is the goal.

We should strive to use our own products early so as to understand their effect on productivity.

WINNING

We will only enter or remain in a product area if we are playing to win. We will withdraw from a product area if we can't state clearly why we are going to win -or- won't dedicate ourselves appropriately to this goal.

Corollary: If we are already winning in a given product area, we will give first priority to maintaining this position: leveraging our installed base, existing products, and distribution channels.

We will not enter into later phases of product design without believable plans to generate high returns through product uniqueness and quality.

Exceptions: We will carefully review those occasional variations to this criterion required to meet specific bid requirements (c.f. IBM channels, DBMS) even though the product is not otherwise a critical (or profitable?) one.

PARTNERSHIP

Focus of our own resources and leveraging off the work of others must be a key premise of our strategy. We will invest to lead and sustain the industrialization of clear, efficient, effective human and machine interface standards over a broad product range.

We've been known historically as a company that makes products to which (and by which) others can easily provide complementary capabilities satisfying particular needs. We aim to continue in this position.

To avoid the time-delay otherwise implied in "partnership" marketing, we need clear long lived standards.

Our products are sold at several different levels of integration simultaneously through many kinds of channels. It's important that each product level stand on its own competitive merits.

The environment of the 1980's will almost certainly include a more intimate relationship between computing and communications. We will seek to cooperate in the development and application of standards tieing together these disciplines.

We will provide appropriate internal and external interfaces to tie our products to local and distributed, public and private communications switching systems supplied by a variety of carriers. We will invest to deal effectively with the integration of voice, data and video images because we believe this is critical to highly productive computing.

QUALITY
Investments we make will be complete enough to ensure the development of products that work as expected in worldwide markets.

The goal must be direct shipment via UPS, customer merge, installation and repair.

We seek to improve our responsiveness to manufacturing issues and provide sufficient co-location so that our engineers will get the necessary feedback to appropriately evolve product designs.

Together with manufacturing, we will seek automated methods that allow an increasingly higher level of consistently delivered quality.

We will invest in design aids that offer the promise of reducing design faults in shipped products.

At a systems level we will invest to provide user-tolerant, self-documenting products that rarely need service - and when service is required, do not involve skilled personnel.

We will invest to develop an increasing degree of data integrity in our products.

PRODUCTIVITY/RESPONSIVENESS
There is a strong possibility that the pace of change in our industry will increase. There are several strong new players in our game. Further, IBM is much less encumbered by its lease base than previously. We need a strategy for improving engineering responsiveness. Some key operating rules are emerging:

Make decisions that can stick (and stick by them);

Do advanced (standards) development so invention need not be incorporated in critical schedules;

Stick to standards (so invention is constrained to only what is critical for a product);

Provide tools for more productive design efforts and understand how our use of resources, especially computers, affect productivity.

Keep some slack resource so unanticipated events can be accommodated.

TECHNOLOGY ASSESSMENT AND RECOMMENDATIONS

Preliminary Draft

This section contains a detailed assessment of DEC's strengths and requirements in critical technology areas. A high-level set of investment recommendations will be added in the final version of this document. We also expect to review and refine the taxonomy as a result of discussions at RAD, TMC, and other groups.

Also included in this section is a graphic assessment of Advanced Development groups at DEC. These summaries are the result of reviews in FY'80 at the RAD committee. More information on these department reviews is available in the RAD FY'80 Annual Report. The idea of using faces, and the illustrations themselves, are Gordon Bell's contribution.

TECHNOLOGY TAXONOMY SUMMARY CHARTS

The following pages are the preliminary form of a technology chart. The purpose of this chart is to show the status of the company in the many different technologies that are significant to it. This information is designed to be a guide for investments into technology areas. The information shown here is from the inputs of many people. The more that this document gets reviewed the more it will reflect the actual status of technologies at DIGITAL.

These pages are summaries. There is more detailed information available. The interpretation of the symbols is shown here.

LEVEL OF NEED

E means Essential to the company products.
P means Profitable and desirable for the company.

SOURCE OF THE TECHNOLOGY

B means that this group Buys this capability.
D means that this group Develops this capability internally.
S means that this group Sells this capability to other groups.

LEVEL OF CAPABILITY

^ means that this group leads the industry in this capability.
\+ means that this group has adequate investments to insure the future of this capability in the company.
= means that this group has adequate capibility for now but not sufficient development work for the future.
\- means that this group does not have adequate capability for the projects currently in development.
v means that this group has a very severe lack of capability.

TECHNOLOGY TAXONOMY SUMMARY CHART

BASE (PRODUCT RELATED) HARDWARE TECHNOLOGIES

Technology Name	SW	T/T T	16-BIT PC	16-BIT 16b	VAX/VMS PC	VAX/VMS MID	VAX/VMS LG.	COM NET	MASS STORE PC	MASS STORE MID	MASS STORE LG.	COMPONENTS LSI	COMPONENTS PI	COMPONENTS PWR	COMPONENTS PKG
SEMICONDUCTORS															
VLSI-MOS	_	0	_	PB+	EB+	PB+	0	EB	EB?			ES+		0	
Gate Arrays	_	0	_	PB+	EB+	EB+	ED+	0	EB?			ES		0	
Special Custom	_	PB^	_	PB+	EB+	EB+	0	PB	EB?			ES		ED=	
VLSI-Bipolar	_	_	_	_	_	_	_	_	_	_	_	ES	_	_	_
MEMORY															
Cost-oriented	_	EB=	_	EB+	EB+	EB+	0	0	EB?			0		0	
Large, MOS	_	EB=	_	EB+	PB+	EB+	EB	EB	EB?			0		0	
Very fast	_	EB=	_	EB+	PB+	EB+	EB+	EB	EB?			0		0	
PHYSICAL INTRCNCT															
Chip carriers	_	PB=	_	ED=	EB-	EB-	EB+	PB=	PB-			ES-		ED^	
PCB's	_	PB=	_	ED=	ED-	ED-	EB+	0	ED-			0		ED^	
Modules	_	PB=	_	ED=	ED-	ED-	EB+	PB-	ED=			0		ED^	
Backplanes	_	PB=	_	ED=	ED-	ED-	EB+	0	ED=			0		ED^	
Inter-box,cab	_	PB=	_	ED=	ED-	ED-	ED+	0	ED=			0		ED^	
POWER SUPPLIES															
Low power	_	EB+	_	EB=	ED+	PB+	0	EB=	EB-			0		ES+	
Elect.quiet	_	EB+	_	EB=	ED+	ED+	0	EB-	EB-			0		ES=	
Hi pwr, Hi eff.	_	0	_	EB=	0	ED+	ED=	0	0			0		ES+	
ELECTRICAL CKTS															
Logic	_	E +	_	ED+	ED+	ED+	ED=	ES+	EB=			0		ED^	
Analog	_	E =	_	ED+	ED+	ED+	ED=	ES-	ED^			0		ED^	
Voice I/O	_	P -	_	ED+	ED+	0	0	PB-	0			0		0	
MASS STORAGE															
Tapes	_	0	_	EB=	EB=	EB-	0	0	ED-			0		0	
Disks	_	0	_	EB=	EB+	EB+	0	0	ED+			0		0	
Floppies	_	0	_	EB=	0B+	0	0	0	ED-			0		0	
DIGITAL SYSTEMS															
MicroPgm Arch.	_	ED=	_	ED-	ED+	ED+	0	ED+	ED=			0		0	
Processor Arch.	_	0	_	ED-	ED+	ED+	0	0	EB?			0		0	
MECHANICS & EM	_	ED+	_	PB-	0	0	0	0	ED+			0		0	
MECHANICAL PKG.															
Prod. specific	_	EB=	_	EB-	ED+	ED+	0	EB=	ED=			0		ES+	
Cabinet	_	0	_	EB-	ED+	ED+	EB+	PB=	EB?			0		ES+	

TECHNOLOGY TAXONOMY SUMMARY CHART

BASE (PRODUCT RELATED) HARDWARE TECHNOLOGIES (cont.)

Technology Name	SW	T/T T	16-BIT PC	16b	VAX/VMS PC	MID	LG.	COM NET	MASS STORE PC	MID	LG.	COMPONENTS LSI	PI	PWR	PKG
SEMICON - SPECIFIC															
Semicond. Circuits	—	—	—	—	—	—	0	—	—	—	—	ES-	—	—	—
Photo-lithography	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ion-implantation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dry/wet chemical etching	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Epitaxy	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Thin films	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Doping	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Metalization	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
New chemistries	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Superconducting materials	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Non-traditional semiconductors	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MASS STORAGE															
Magnetic heads	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Magnetic media	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Information theory	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
File systems	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
COMMUNICATIONS															
Digital filters	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Multi-drop optics	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Encryption/Secure	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Digital switching	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Voice switching	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Modem design	—	EB-	—	—	—	—	—	—	—	—	—	—	—	—	—
High speed lines	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TERMINALS and TRANSDUCERS															
Keyboards	—	ES=	—	—	—	—	—	—	—	—	—	—	—	—	—
Touch input	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Telephony	—	ED-	—	—	—	—	—	—	—	—	—	—	—	—	—
Impact Printing															
Heads	—	ED+	—	—	—	—	—	—	—	—	—	—	—	—	—
Ribbons	—	ED+	—	—	—	—	—	—	—	—	—	—	—	—	—
Non Impact Print.	—	PB=	—	—	—	—	—	—	—	—	—	—	—	—	—
Paper handling	—	PD+	—	—	—	—	—	—	—	—	—	—	—	—	—
CRT displays	—	ES-	—	—	—	—	—	—	—	—	—	—	—	—	—
Video Architect.	—	ED^	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other displays	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MECHANICAL															
Acoustical Eng.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Thermal Eng.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Structural Anal.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TECHNOLOGY TAXONOMY SUMMARY CHART

BASE (PRODUCT RELATED) SOFTWARE TECHNOLOGIES

Technology Name	SW	T/T	16-BIT		VAX/VMS			COM	MASS STORE			COMPONENTS			
		T	PC	16b	PC	MID	LG.	NET	PC	MID	LG.	LSI	PI	PWR	PKG
SW. Architecture	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
SW. Management	ED=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
SW. Performance	ED=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Distributed Proc.	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Gen. Tech. Comput.	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Gen. Cmmrl. DP	PD=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
HW. Architecture	EB+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Operating systems	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Syst. Architecture	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Security & Crypt.	PB-	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Reliabl. & Recovery	ED=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Data Integrity	ED=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Availability	ED=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Netwrk. & Communi.	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Graphics SW.	PDv	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Real Time	PD=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Language Design	PD=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Compiler Design	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Information Mgmt.	ED-	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Dist. Data Mgmt.	ED-	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Text Mgmt.	ED-	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Image/Voice Mgmt.	PDv	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Customization OpSys	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Customization Apps	ED-	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Art. Intelligence	PDv	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Recognition and Synthesis	PDv	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Technology of the Applications	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_

TECHNOLOGY TAXONOMY SUMMARY CHART

ENGINEERING PROCESS CAPABILITY

Technology Name	SW	T/T T	16-BIT PC	16-BIT 16b	VAX/VMS PC	VAX/VMS MID	VAX/VMS LG.	COM NET	MASS STORE PC	MASS STORE MID	MASS STORE LG.	COMPONENTS LSI	COMPONENTS PI	COMPONENTS PWR	COMPONENTS PKG
DIGITAL CAD															
CAD Arch	_	EB=	_	EB=	_	_	ED=	0	?			ED+		0	
Network anal	_	EB=	_	EB=	_	_	0	PB	?			0		0	
System Perf.	_	EB=	_	EB=	_	_	0	PB	ED+			0		0	
System Analysis	_	EB=	_	EB=	_	_	0	PB-	ED^			0		0	
System Design	_	EB=	_	EB=	_	_	0	0	ED^			0		0	
Arch. spc/verfy	_	EB=	_	EB=	_	_	0	0	ED=			ED=		0	
Firmware	_	EB=	_	EB=	_	_	0	0	ED+			ES=		0	
Logic Design	_	EB=	_	EB=	_	_	0	EB=	ED=			ED=		0	
Discrr. Simulat.	_	EB=	_	EB=	_	_	0	0	ED+			0		0	
Microprogramming	_	EB=	_	EB=	_	_	0	ED+	ED+			0		0	
Logic fault sim.	_	_	_	_	_	_	_	_	_	_	_	ED+		0	
LOGICAL-PHYSICAL															
PCB Design	_	EB=	_	PB=	_	_	EB=	EB=	ED=			0		0	
Analog PCB	_	EB=	_	PB=	_	_	EB=	EB-	ED+			0		0	
Other PI Layout	_	EB=	_	PB=	_	_	EB=	0	?			0		0	
VLSI Layout	_	EB=	_	PB=	_	_	EB=	0	ED-			ED=		0	
Gate Array	_	_	_	_	_	_	EB=	0	ED-			ED=		0	
ELECTRICAL CAD															
Semi circuit	_	EB=	_	0	_	_	EB=	0	EB=			ED=		ED-	
Elect. circt.	_	EB=	_	0	_	_	EB=	PB?	EB=			0		ED+	
Control theory	_	EB=	_	0	_	_	0	0	ED=			0		ED+	
Magnetic sim.	_	EB=	_	0	_	_	0	0	ED=			0		ED=	
MECH. CAD/CAM														ED+	
Finite Analysis	_	EB=	_	0	_	_	B	0	ED+			0		_	
Finite diff.	_	EB=	_	0	_	_	B	0	EB-			0		_	
Heat transfer	_	EB=	_	0	_	_	B	0	EB?			0		_	
N/C milling	_	EB=	_	0	_	_	B	0	ED+			0		E	
TESTING															
Syst. verif.	_	EB=	_	EB=	_	_	E =	0	EB?			0			
Environment	_	EB=	_	EB=	_	_	E =	0	EB?			0		EB+	
RFI	_	EB=	_	EB=	_	_	E =	EB=	EB?			0		EB+	
Acoustic	_	EB=	_	EB=	_	_	E =	0	EB?			0		ES	

TECHNOLOGY TAXONOMY SUMMARY CHART

ENGINEERING PROCESS CAPABILITY (cont.)

Technology Name	SW	T/T T	16-BIT PC	16-BIT 16b	VAX/VMS PC	VAX/VMS MID	VAX/VMS LG.	COM NET	MASS STORE PC	MASS STORE MID	MASS STORE LG.	COMPONENTS LSI	COMPONENTS PI	COMPONENTS PWR	COMPONENTS PKG
PWR PKG - SPECIFIC															
Geometric Design	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Struc. Anal.	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Heat Transfer Anal	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
General CAD tools	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Acoustic CAD tools	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Systems Eng/Arch	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Data Base/Netwrkng	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Appplications (Eng. & Mfg)	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Analysis	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Thermal Design	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Acoustical Design	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Reliability Model.	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Structural Design	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
SW. Design	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
SW. Implementation	ED+	_	_	_	_	_	_	_	_	_	_	_	_	_	_
SW. Verification/ Validation	PD=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
SW. Documentation	PD=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
SW. Performance	ED=	_	_	_	_	_	_	_	_	_	_	_	_	_	_

TECHNOLOGY TAXONOMY SUMMARY CHART

MANUFACTURING PROCESS TECHNOLOGIES

Technology Name	SW	T/T	16-BIT		VAX/VMS			COM	MASS STORE			COMPONENTS			
		T	PC	16b	PC	MID	LG.	NET	PC	MID	LG.	LSI	PI	PWR	PKG
SEMICONDUCTORS															
VLSI-MOS	_	0	_	EB=	_	_	_	0	EB?			ES=	_	_	_
Bipolar G A	_	0	_	EB=	_	_	_	0	EB?			ES=	_	_	_
ECL G A	_	0	_	EB=	_	_	E	0	EB?			_	_	_	_
Solder bumps	_	0	_	EB=	_	_	P	0	EB?			ED-	_	_	_
FTA chips	_	0	_	EB=	_	_	_	0	EB?			_	_	_	_
PHYSICAL INTERCON.															
(implies assy & test)															
Chip carriers	_	EB=	_	0	_	_	E	PB?	_	_	_	_	_	_	_
Thin film dep.	_	EB=	_	0	_	_	_	0	_	_	_	_	_	_	_
PCB's	_	EB=	_	0	_	_	_	0	_	_	_	_	_	_	_
Multi-layer	_	EB=	_	0	_	_	E	EB-	_	_	_	_	_	_	_
Control imped.	_	EB=	_	0	_	_	E	0	_	_	_	_	_	_	_
Modules	_	EB=	_	0	_	_	_	PB-	_	_	_	_	_	_	_
FTA modules	_	EB=	_	0	_	_	_	0	_	_	_	_	_	_	_
Backplanes	_	EB=	_	0	_	_	E	0	_	_	_	_	_	_	_
Cables	_	EB=	_	0	_	_	_	0	_	_	_	_	_	_	_
Inter-box,cab	_	EB=	_	0	_	_	_	0	_	_	_	_	_	_	_
SPECIAL TEST															
System	_	EB=	_	0	_	_	_	ED-	_	_	_	_	_	_	_
Network	_	EB=	_	0	_	_	_	ED-	_	_	_	_	_	_	_
RFI	_	EB=	_	0	_	_	_	EB=	_	_	_	_	_	_	_
POWER SUPPLIES	_	EB=	_	0	_	_	E	PB?	_	_	_	_	_	_	_
ANALOG CIRCUITRY	_	0	_	0	_	_	_	PB-	_	_	_	_	_	_	_
MECHANICS & EM	_	0	_	0	_	_	_	0	_	_	_	_	_	_	_
Castings	_	EB=	_	0	_	_	_	0	_	_	_	_	_	ES=	_
Plastic molding	_	EB=	_	0	_	_	_	0	_	_	_	_	_	ES=	_
Machined parts	_	EB=	_	0	_	_	_	0	_	_	_	_	_	ES+	_
Stampings	_	EB=	_	0	_	_	_	0	_	_	_	_	_	ES+	_
Etching	_	EB=	_	0	_	_	_	0	_	_	_	_	_	ES=	_
Ship cartons	_	EB=	_	0	_	_	_	0	_	_	_	_	_	_	_
MATERIALS FLOW	_	EB=	_	0	_	_	_	0	_	_	_	_	_	_	_
PWR PKG - SPECIFIC															
Automation	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Mechanization	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Programmable Automation	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Finishing/coating	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Plating/Painting	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Analog Circuitry	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Hybrid Thick Film	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Pwr Supply Cont. Module	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_

TECHNOLOGY TAXONOMY SUMMARY CHART

SERVICE AND USE TECHNOLOGIES

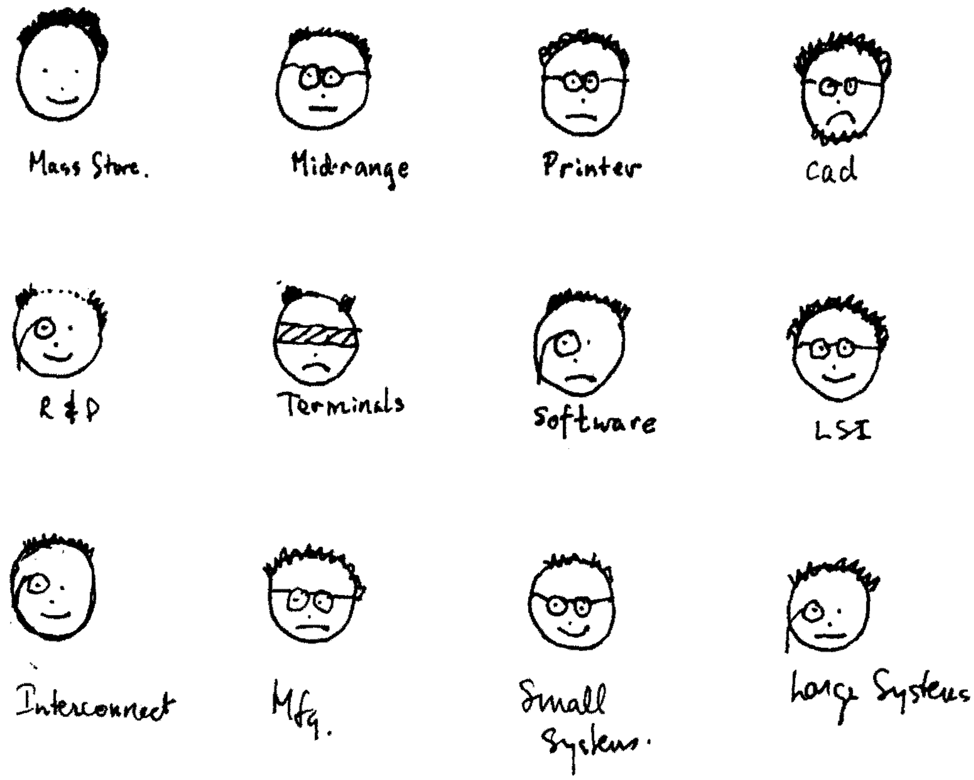
Technology Name T/T |16-BIT | VAX/VMS |COM| MASS STORAGE | COMPONENTS
T PC 16b PC MID LG. NET| T PC MID LG.|LSI PI PWR PKG

Technology Name	SW	T/T T	16-BIT PC	16-BIT 16b	VAX/VMS PC	VAX/VMS MID	VAX/VMS LG.	COM NET	MASS STORE PC	MASS STORE MID	MASS STORE LG.	COMPONENTS LSI	COMPONENTS PI	COMPONENTS PWR	COMPONENTS PKG
HUMAN FACTORS	PD=	EB=	_	EB=	_	_	_	0	_	_	_	_	_	_	_
Self-help	_	EB=	_	EB=	_	_	_	EB-	_	_	_	_	_	_	_
Manuals	_	EB=	_	EB=	_	_	_	PB=	_	_	_	_	_	_	_
Productivity	_	EB=	_	EB=	_	_	_	0	_	_	_	_	_	_	_
RAMP															
Reliablity	_	EB=	_	ED-	_	_	_	0	_	_	_	_	_	ED-	_
Non-Stop	_	EB=	_	ED-	_	_	_	0	_	_	_	_	_	_	_
Availability	_	EB=	_	ED-	_	_	_	EB-	_	_	_	_	_	_	_
Maintainability	PD-	EB=	_	ED-	_	_	_	EB-	_	_	_	_	_	_	_
USER-DESIGN															
Perf. Tools	_	EB=	_	ED-	_	_	_	ES-	_	_	_	_	_	_	_
Network maint.	_	EB=	_	ED-	_	_	_	ES-	_	_	_	_	_	_	_
USER-BUILDABLE	_	EB=	_	ED-	_	_	_	EDv	_	_	_	_	_	_	_
USER-MAINTAINABLE	PD-	EB=	_	ED-	_	_	_	EDv	_	_	_	_	_	_	_

ENGINEERING PROCESS MANAGEMENT

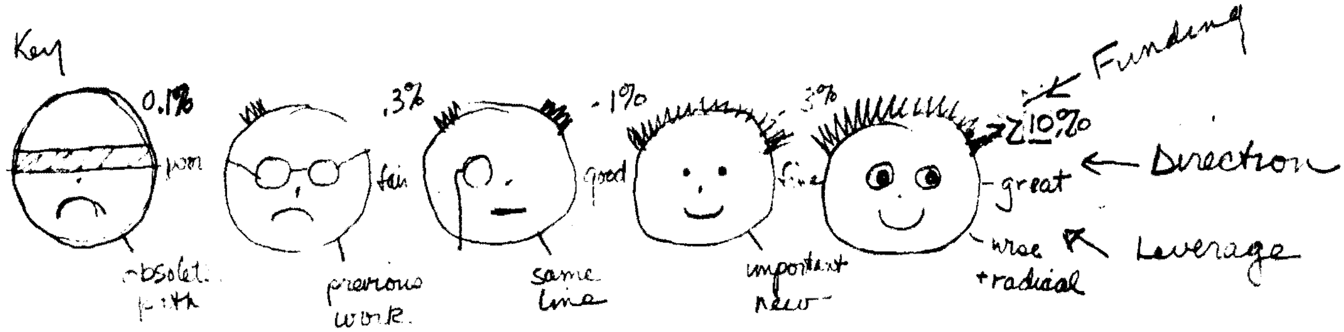
Technology Name	SW	T/T T	16-BIT PC	16-BIT 16b	VAX/VMS PC	VAX/VMS MID	VAX/VMS LG.	COM NET	MASS STORE PC	MASS STORE MID	MASS STORE LG.	COMPONENTS LSI	COMPONENTS PI	COMPONENTS PWR	COMPONENTS PKG
PROJECT CONTROL	_	EB=	_	ED-	_	_	_	_	_	_	_	_	_	_	_
HRP	_	EB=	_	ED=	_	_	_	_	_	_	_	_	_	_	_
Personnel Develop.	PD=	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Communications & Decision making.	PD=		_		_	_	_	_	_	_	_	_	_	_	_
TECHNICAL EDUCATION	_	EB=	_	PB=	_	_	_	_	_	_	_	_	_	_	_
SPACE PLANNING	_	EB=	_	0	_	_	_	_	_	_	_	_	_	_	_
COMPUTING RESOURCES	_	EB=	_	EB=	_	_	_	_	_	_	_	_	_	_	_

LW 1:13



FY'80 Status of Advanced Development, by Group

JB 3/13/81



DEC'S POSITION IN THE VAN
(VALUED-ADDED-NETWORK OF SUPPLIERS AND CONSUMERS)

We have an industry position in "partnership" with those who provide end user services.

It is our assumption that we wish generally to increase partnership activities overall, limiting direct efforts to areas where we have particular competance and potential. In this, we balanced the benefits below:

LESS PARTNERSHIP (MORE DIRECT,...)	MORE PARTNERSHIP

. More market control as our suppliers forward integrate (potentially around us);
. More insite to end-user needs;
. Less dependence on OEM skills;
. Less vulnerability to economic cycles
. More danger of high investment levels in obsolete technologies
	. Less resource drain for end-user applications development;
	. More market breadth for products
	  . for higher product volume
	  . more opportunity to succeed in the absence of a complete, acceptable solution
	  . leverage off the ideas and investments of others;
	. Less possibility of getting caught in a saturated point market;
	. Clearer product feedback;
	. OEM test of our output at several integration levels

We seem to be in a "technologically inspired market". As a company we have a strength in distribution channels that we wish to emphasize.

Our policy on vertical integration (as follows) is consequent to this judgement and a consideration of the individual cases detailed later:

- **Invest only in necessitites, not for incremental revenue or profit.**

- **Provide the productivity tools to encourage massive levels of applications development by others on our systems.**

The criteria we will use in selecting areas for vertical investment are:

- First to ensure sources of supply, e.g. for disk supply that may dry up if controlled by a few large manufacturers. (This requires the test of clear and convincing evidence.)

- Then to get technology that is required for leadership proprietary function especially that which is visable to the user (e.g. personal computer terminals and these semiconductor processes and design tools to support leadership DEC products and proprietary architectures).

- Lastly, if ever, to internalize the base products needed for a large part of our revenues.

As a result of applying these policies/criteria we wish to allow the following corporate development.

```
                        B A C K W A R D   I N T E G R A T I O N

F               lo           (% SELF-MANUFACTURE)                       hi
O             ---------------------------------------------------------------
R    % lo   | K-MART                      |                                 |
W           |                             |                           INTEL |
A    S      |            APPLE            |                                 |
R           | SEARS                       |      DEC '90       FUJITSU      |
D    E      |                             |                                 |
            |          DEC '75            |                                 |
I    R      |                             |                                 |
N           |           DEC '80           |                                 |
T    V      |- - - - - - - - - - - - - - -|- - - - - - - - - - - - - - - - |
E           |                             |                                 |
G    I      |                             |                                 |
R           |                             |                                 |
A    C      | ADP                         |                             IBM |
T           |                             |                                 |
I    E      |  Schlumberger               |                      AT&T       |
N     hi    |-----------------------------|---------------------------------|
            |                             |                                 |
```

(This picture is probably too simplistic. It might be valuable to separate out, say, low-end high-end, computing vs. communications, ...)

WE WILL INVEST TO ACCOMPLISH SOMEWHAT MORE BACKWARD INTEGRATION TO:

- Increase security of supply: where this is critical to our business;
- Have better potential for leadership products by control of product definition;
- Maintain trade secret protection and the advantage of (unique) proprietary products
- Provide better internal responsiveness to our needs than outside suppliers would/will provide (and thus potentially shorter time-to-market for new products);

WE CHOOSE TO DEPEND LESS ON FORWARD INTEGRATION BECAUSE:

- DEC's success has been/will continue to be as a product company;
- Fundamentally we are better off if we provide products that don't need services to be useful;
- We project increasing difficulty in getting trained people: only products that don't need service don't need people.
- Cash looks better applied in providing better products than in providing more services. (This is due to expected productivity of capital assets vis-a-vis more direct labor);
- We project a crunch in service profit as a no-profit policy is played out by Fujitsu (and others).

This does not imply that we should not derive what profit we can from our service operations. As an engineering organization, however, we should provide products that to an increasing degree do not require service for maintenance, not for facilities management, not for custom installation, not for training, ...

We have some history with prior decisions to vertically integrate our supply. Some (e.g. terminals and "boards") we have chosen to sell on the open market. Some others (e.g. power supplies and most semiconductors) we have not. Recognizing the tradeoffs as detailed below, our overall policy is to subject vertical integration to the market test.

INTERNAL USE ONLY	OPEN MARKET SALES
Better responsiveness to internal demand shifts	More volume/scale
Retained focus on systems business	Clearer (economic) market feedback
More cooperation in fixing problems	Increased incentive/drive
Less management in dilution to work on market charter hassles,...	Better customer coupling
Reduced need for (complex) allocation schemes	More sensitivity to (cost) requirements
	Less chance of hanging on to an obsolete technical position
	Spreads DEC's name
	Develops new channels
	Value-added on DEC products by more people (leveraging ideas/assets)

For these reasons it is important when we indulge in vertical integration that we maintain a clear understanding of what we expect to get from the investment.

In terms of forward integration, the picture looks like this:

AREA	FUNDAMENTAL BENEFITS TO DEC	SUCCESS CRITERIA	INVESTMENT STRATEGY
Applications (Bill Johnson)	Elapsed time for customer implementation Broader markets (for growth?)	We establish the environment that most people build on ("code share")	Supply higher level tools Don't import systems software
Services (?)	Image as a manufacturer of high productivity (low hassle, high personal leverage) products	Make services unnecessary	Specific attention to methods reducing design faults. (design auto.) Repeatable processes than can be turned for lower product failure (process automation?) Failure tolerant systems (and subsystems) Self-instruction Self-repair Self-installation

AREA	KEY DEC BENEFIT	SUCCESS	SUPPLIERS/VENTURES	INVESTMENT
Power Supplies (H. Schalke)	Design-to-Fit Time to Market Potential Quality	Users seek to buy internally Meet MBTF specs	Look at Sanyo et al. for <50w and for low volume, high power	Design standard power pieces Minimize design
Physical Connect (Will Thompson)	Volume capacity at spec Cost/manufacturability Turn-around time Fewer mfg. test levels Integrate DEC/non-DEC parts	1 Wk. correctly stuffed bds. 200-300 pins/ sq. in. by '90 Suppliers cost	Fujitsu? Must develop outside suppliers	Fast turnaround manufacturability tools Up process density Integrate test philosophy
Disks (Grant Saviers)	Leadership systems image (quality, RAMP, cost/performance) Responsive system design (higher level file system opportunity) Volume capacity	Leadership cost Unique systems position Capacity supports revenue	J.V. w/HP and other systems competitors. Try Japan: Fujitsu, NEC (??), ... Buffer shrinking supplier base	Be ready to maintain supply position. Explore unique systems possibilities Buy commodities Build solid technical base/exploit broadly
Semi-conductors (Jim Cudmore)	Quaranteed supply of proprietary leadership function Turnaround time Control of base computing technology (cost/performance, density/speed/...)	Broad desire to use in design Use of only a few processes Turnaround in 5 days Code share on DEC standards	Commodities generally available. Harris Suppliers becoming or becoming owned by competitors	DEC Design System: tools & product architectures Education program Smart process selection Absorb outside technology
Terminals (Si Lyle/ Bill Picott)	Extension of DEC's name Development of new channels/markets Leadership systems image: packaging, graphics, color, voice, intelligence	Productivity leadership Dispersion of processing to DEC terminals Quality/MTBF	J.V. w/CRT suppliers Graphics equipment suppliers	Understand cognitive factors/ergonomics Distribute extended user interfaces to DEC terminals/ personal computers Stimulate code share

COMPANY CONFIDENTIAL

BUYOUT PHILOSOPHY/PROCESS/CRITERIA

BUYOUT PHILOSOPHY

Buyouts provide a mechanism which can give us significant leverage. We can utilize the work of others and focus our own resources on those issues which have the greatest strategic impact. The make/buy decision should always be supportive of our long term strategic plan. Where the issue is not covered or the decision is unclear given the criteria in the strategic plan, the specific decision is driven by the Program Manager at the appropriate level. (Refer to the attached flowchart for details.)

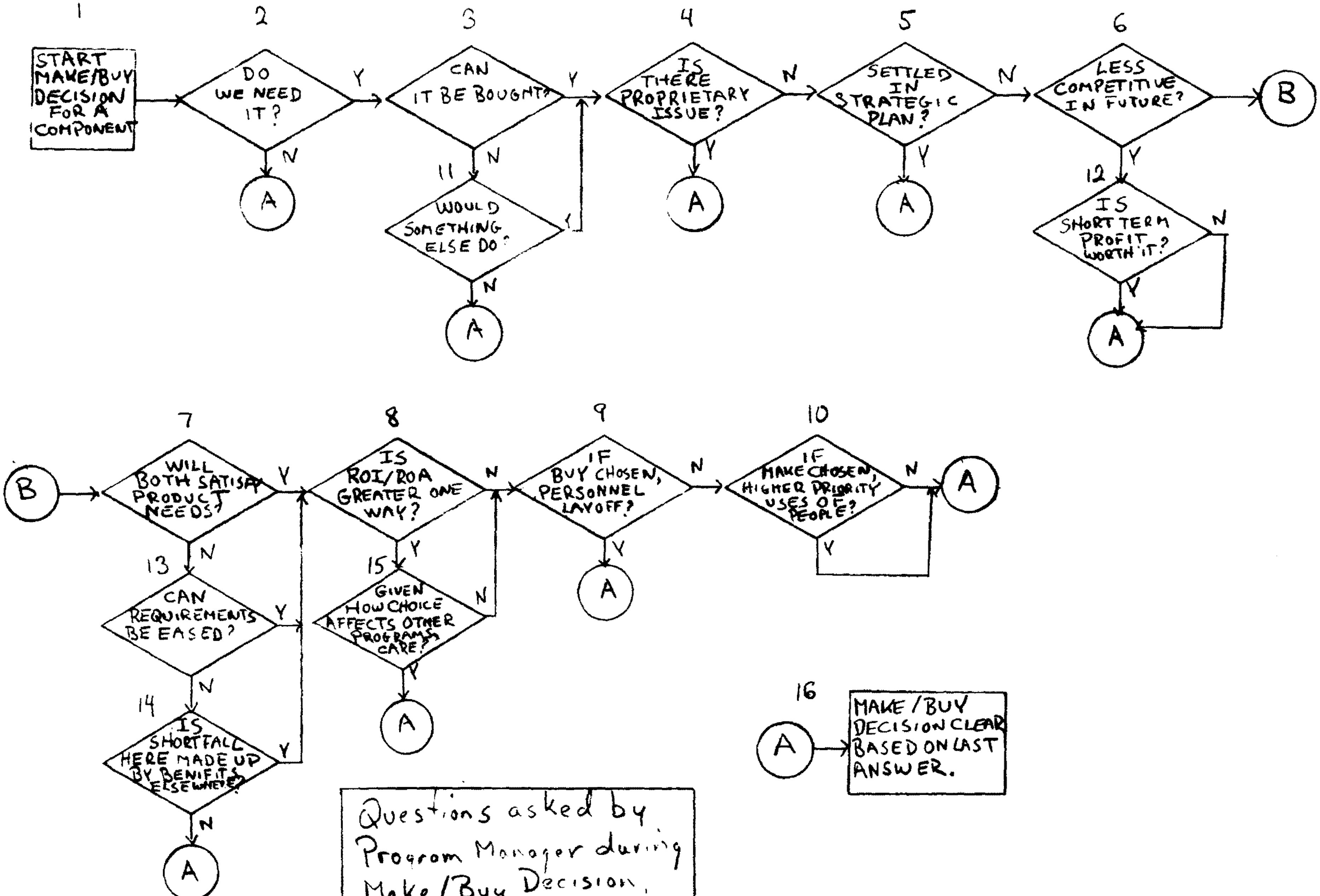
A general principle is to let the free market operate. In other words, unless otherwise specifically mandated in the strategic plan, the Program Manager should be able to purchase his components in the optimal way for his program. Further, the group producing the component should sell (or be able to sell) the component on the open market. This should insure that internal groups remain competitive with the outside suppliers. Obviously there are issues of proprietary products, sub-optimization and internal group startup that must be considered in the strategic plan.

PROCESS

In addition to the overall long term strategic plan, each program has its own strategic plan which is supportive of the long term plan and provides more details. Ideally, the Program Manager does not have line responsibility which might bias him towards make rather than buy. In the cases where he has line responsibility, (today most Program Managers do) it is critical that there be a strong advocate for the buy position. The Strategic Planning Manager provides a mechanism by which both the overall and the program specific strategic plans get created, reviewed, and/or modified. At the project level the Phase 0 Review requires a review of the alternative strategies including the make/buy decision. Finance should assist in the analysis of the numbers provided.

MEASUREMENT CRITERIA

Each of the program areas is working on developing output measurements. Clearly some revenue/cost equation provides one measure of a group's effectiveness. Also, in many cases it should be possible to do a retrospective review of the make/buy decision. eg. If we decided to make it, were the projected financials met? If it is available on the outside, how successful is the product? Is it replacing our offering in add on sales? etc. Finally, a very simple and clear test. If, at any time, the people doing the development state that that they have insufficient resources to build a winning product (however defined when the make decision was finalized), then we chose the wrong alternative!



Questions asked by Program Manager during Make/Buy Decision.

LEGEND: Number above each box corresponds to a more detailed question on the attached sheet.

PvR 3/2/81

REFERENCE NUMBERS FROM MAKE VS BUY FLOWCHART

1. The Program Manager asks a set of questions to determine the make/buy tradeoff.

2. Could we completely avoid the need for this component by utilizing some existing component and adjusting some other component or system requirement?

3. Is the component available on the outside?

4. Does the component represent a proprietary issue for DEC? (Not just a patent issue but also a marketing question).

5. Does the overall DEC Strategic Plan or the Program Level Strategic Plan require that this component be made or bought?

6. Will selection of either approach cause DEC to become less competitive in the future? eg. lack of suppliers, missing internal skills, or technology gap.

7. Can both make or buy options satisfy functionality, quality, transfer cost, and time to market requirements?

8. Is the ROI/ROA greater in one approach? eg. Plant loading, start up costs, etc.

9. If the buy approach is utilized, can adequate plans be developed to utilize the DEC people within this or other programs?

10. If the make approach is utilized, are there higher priority uses for the DEC people for which they are qualified?

11. Could we use what exists in the outside market by adjusting some other component or changing the system requirements?

12. Is the short term profit worth the long term loss?

13. Could one of the requirements be eased so that either approach would be acceptable?

14. Is the faulty element in either the make or buy approach compensated for by benifits to other programs? (This question must be answered jointly by all Program Managers and Finance.)

15. When the greater ROI/ROA is examined in the light of other programs is it still a factor?

16. END. Decision is clear.

EXAMPLE OF A "MAKE VS. BUY" ANALYSIS

This section presents the issue of high-end disk investment as a case study for "make vs. buy" analysis. The following memos illustrate the complexity of decisions about backward integration.

CURSORY THOUGHTS ON HIGH END DISKS by Gordon Bell

While I support investing in mass storage technology, I don't believe we should build higher end disks, because:

1. It stretches our range, and level of integration farther, and I believe it is too large for the money we are investing. I think we should try harder to cap our systems at $250K.

2. There are two low end threats to our traditional mid range business that are going to require resources: the personal computer involving both floppies and hard disks; and the small shared system is now sub-19" rack and will require hard disks.

3. We are biting off too much: floppies, Smaller winis, Aztec, Pinon, and evolving the R80, through the 81 and beyond. We're doing too much to get in manufacturing: T/E (2.5K), 5" wini (6.25K), Aztec (16K), Pinon (100K), R81/TU78 (>100K), and RP07 (in mfg.).

4. These disks take a disproportionate share of engineering resources for a disproportionate part of the revenue. Also, they are technically the most difficult to do. Given our limited engineering budget vis a vis the Japanese, HP, and IBM, I believe we have to select.

5. It is more important to have a better system range and to fund the important generic applications, such as the OFIS program than to backward integrate into this part of the system range.

6. We are not a dominant part of the market in terms of units, and hence we will not get the costs vis a vis the BCG learning curves. CDC (NPI), Fujitsu, Nippon

Peripherals, STC and IBM all cover us.

7. Maybe there is a joint venture that would be satisfactory such that the facility would get market share.

8. We are not a dominant supplier in this part of the business and hence will not get the volume to make the investment worthwhile. Note the small number of RP07s ordered.

9. If we ever start looking at roi/roa, there's no way to justify this investment. Buying out or joint ventures will be much better...provided we don't handle them to death in our multi-FAT sites.

10. We should get our better cost/megabyte by going after more aggressive mid-range system disks and then putting several of them on the larger systems.

11. Our successful products are those that go across both end user and OEMs. This would only go into the less profitable end user segment.

12. From a general direction standpoint, I think we should consolidate the range of products we have and invest in layered software together with the networking, while only manufacturing the parts where we make a dominant volume of the market needs, i.e. the mid range. This is the make criteria to be successful in the OEM business.

COMMENTS by Grant Saviers

1. It stretches our range: Our average 11/780 system is selling now for >$250K. Venus is certain to raise the ASP even higner. If Venus is to be a major system from a revenue viewpoint, we must have competitive, profitable disks. An alternative is to market Venus as a CPU, allowing others to integrate the systems and or sell the disks. This might be an acceptable strategy for a small market at the extreme of our range. Two major risks to this strategy are the willingness of customers to deal with multiple suppliers and lack of account control (sales and service).

2. Low end threats: We are expanding our range downwards with CT and agree that this extension is requiring additional disk products.

3. Biting off too much: We (development) believe that 25% to 30% year to year real growth is a realistic management limit. At current inflation rates this translates to 35% to 40% funding growth. The manufacturing growth rate has been 5% to 10% higher because of the rising percentage of NES in storage and continuing increase in the make/buy ratio.

4. Unfavorable ROI: Our large disk analysis indicated a favorable ROI. Our FY82 large disk only (no systems, controllers) NES is about $300M. Our current investment (fully loaded) is about $2M/year. It appears that any disproportionate investment is elsewhere.

5. Generic applications and systems breadth are more important integrations: It would seem that making what we know how to sell in high volume (large disks) has lower risks.

6. We have a small market share: We buy more disks than <u>any</u> other systems manufacturer in the world. IBM, CDC, Univac, Burroughs, NCR (via joint venture), HIS (via joint venture), Fujitsu, Hitachi, NEZ make their large disks. We will purchase about 8,000 large disks in FY81. This is more than MRX's or ISS/Univac production. It is about 3X Fujitsu's or Hitachi's production rate. CDC and STC produce about 10K-15K per year. IBM's 1980 annual report states "ten's of thousands of magnetic disk files... are being shipped to customers annually". Our large disk

usage has been growing at an annual unit rate in excess of 40%. If we produced our current products, we would be a major producer.

DEC's share of OEM shipments* (Non-captive)

1. Pack Drives (>100 MB)

	CY79	CY80	CY81	CY82	CY83
A. CDC	7500	13000	16500	18000	17000
B. MRX	5000	6500	6000	4500	2600
C. Other	800	6500	7400	7200	6500
D. Total (WW)	13300	26000	29900	29700	26100
E. Total DEC	3400	4300	6100	6100	5300
F. DEC % / WW	26%	17%	20%	21%	20%
2. Fixed Media (>200 MB)					
G. Total WW	100	900	3200	5400	7600
H. Total DEC	-	-	500	1700	2800
I. DEC % / WW	-	-	16%	32%	38%
3. Total DEC % / WW OEM Disks (>100 MB)					
J. WW Total	13400	26900	32100	35100	33700
K. DEC Total	3400	4300	6600	7800	8100
L. DEC %/WW Total	25%	16%	21%	22%	24%

* Source for Worldwide (WW) data 1980 Disk Trend Report + CDC input.

NOTE: IBM large disk products are typically about 30,000 units per year.

7. Joint venturing looks attractive: We have given this considerable thought and see the guidelines for joint venturing as:

Why we might be interested:

- We can't afford it, but need it
- Skill need beyond our abilities
- Acquisition of a technology base
- Political/tariff/government pressures
- Economical facility too large for DEC
- Only game in town

Hygenic factors:

- Our value added is elsewhere
- OK for competitor to have it
- We can work with the partners
- Adequate control of the results

- Partners contribute value

8. Small number of RPØ7's ordered: The Product Line requests are disappointingly low. We see this as a consequence of the earlier 3ØØ MB cancellation, the RMØ5 introduction, large backlogs, and risk aversion.

9. Buy out or joint venture, don't FAT: Buyouts will always find the test of being competitively profitable unless we can market at 1.8X markup. 25% of the $15ØK and up systems costs (current large disks) could be shipped to customers from the volume factory (ours or suppliers). This should be done in any case.

10. Multiple mid-range disks to cover our large needs: This appears attractive and may be a viable solution. However, it requires a competitive technology base (hence investment). We are carefully examining this alternative as it may give us fewer better products.

11. Successfull products go OEM. Large disks "only go into the less profitable and user segment". We want to sell OEM and today have products that are saleable. We only build OEM competitive storage products. If end user is less profitable, why enphasize "generic applications" (#5)?

12. Invest in layered software and networking. Make only in the mid range. My view is to invest in a few key hardware technologies and leverage these technologies into products across our range. This should maximize ROI/ROA and establish adequate volume/market share to be competitive.

GB2.S4.6

ENGINEERING INVESTMENT SIEVE

1. Winning program for distributing processing over the range of departmental to personal computers.

   . Leadership to terminals since all terminals are computers (personal computers and terminals merge).

   . Provide a desireable base for multiple software vendors to independently build on - resulting in an integrated, effective offering.

   . Preeminance in local area nets: communications concentrators/ gateways, fileservers, person servers.

   . Be aggressive as possible on VAX.

   . Develop a much deeper competance in human i/o capabilities.

   . Understand role of integrated communications-and-computing competitors.

2. Get back on the leadership (small) systems curve(s).

   . Break thru cost limits imposed by conventional form factors.

   . Invest in the approaches to storage that maintain competitive systems position.

3. Manage complex technologies and provide them to our customers in
simple, effective packages.

   . Be able to design (proprietary) systems products on silicon.

   . Learn how to manage/provide appropriate (CAD) tools to handle or hide complexity in the design process. Do it before the next major program.

   . Make service, installation and training unnecessary. (Product required services = 0)

C O M P A N Y   C O N F I D E N T I A L

CHAPTER III

ESSAYS ON STRATEGIC THREATS AND OPPORTUNITIES

OVERVIEW

As we look to DEC's future, we face a multitude of uncertainties in the external environment. We must anticipate the threats from aggressive competitors, government regulators, and an unstable world economy while exploiting the opportunities from advancing technology and the seemingly limitless demand for information processing. This Chapter is a collection of essays on the external environment.

1. Strategic Threats by Bruce Delagi

   A very brief, prioritized summary of key competitive threats as developed by the Engineering Staff at several Woods.

2. Getting Organized in Engineering and Manufacturing to Face Our Future Competitors by Gordon Bell

   A memo to the Group Vice-President of Manufacturing discussing competitive strengths and weaknesses.

3. View of Competitors by Gordon Bell

   Some additional commentary on IBM and other competitors.

4. Telecommunications Environment by Bruce Delagi

   A brief essay on the strategic implications of the joining of data processing, communications, and office automation.

5. Competitive Technology Directions by Bruce Delagi

   Bruce divides computing technology into twenty (20) major categories and then plots the strengths and directions of several competitors in this technology space. He concludes that DEC's best strategic positioning can be achieved by significant enhancement of our strength in man-machine interfaces.

STRATEGIC THREATS
(INTEGRATED/FILTERED AND PRIORITIZED)

1. LOSS OF IMAGE AS (THE) LEADER IN EFFECTIVE COMPUTING STYLES

. high productivity terminals	(Apollo, 3Rivers, Convergent?)
. programmer productivity	(IBM System 38, INTEL 432 ADA "capabilities"
. relational data bases	(IBM System/R)
. dispersed processing	(Xerox, Apollo, Datapoint, servers, and intelligent you-name-its)

2. USER/INDUSTRY ACCEPTANCE OF THE "WRONG" STANDARDS

. SNA lockout/account control	(IBM)
. WPS "standardization"	(WANG)
. integrated comp/communications	(NEC, ROLM, EXXON, XEROX?)

3. POTENTIAL DEVELOPMENT OF AN IMAGE OF SECOND-RATE QUALITY

. doesn't fail	(Fujitsu, Tandem)
. data integrity	(IBM now, Future 432 file system?)

4. UNRESPONSIVENESS (IN COST OR FUNCTION) TO INCREASED RATES OF CHANGE

. lease base reduction	(IBM)
. entry of technology companies	(Fujitsu, NEC, Hitachi)
. entry of communications co's.	(NEC, AT&T?, Intelmatique)
. entry of office products co's.	(XEROX)

5. MARGIN/PRICE PRESSURES

. mass storage price/capacity	(Fujitsu, IBM?)
. non-profit service	(Fujitsu)
. vertically integrated competitors	
. long-term view of profit	(Hitachi, NEC, Fujitsu, MITI)

C O M P A N Y   C O N F I D E N T I A L

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* d i g i t a l *
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TO: DICK CLAYTON
TED JOHNSON
MFG STAFF:
OOD:
JACK SMITH

DATE: THU 11 DEC 1980 10:16
FROM: GORDON BELL
DEPT: OOD
EXT: 223-2236
LOC/MAIL STOP: ML12-1/A51

SUBJECT: GETTING ORGANIZED IN ENGINEERING AND MANUFACTURING LIMITS TO FACE OUR FUTURE COMPETITORS [UPDATED FROM 10/26/79]

I'm still feeling good about our current and next few years of products; but I'm terrified about '83-'90 because I think we'll enter a more cost sensitive, commodity oriented market where emphasis is simultaneously cost AND quality. The challenge will be great in products-, process-, and manufacturing-engineering.

The four competitors of concern are IBM (everywhere), TI (only at low end and as a supplier), Intel (typifying the semiconductor revolution implicit in fifth and sixth generation computers of the early and late 80s) and the Japanese (Hitachi, Fujitsu, and NEC; also maybe others). Although each have some unique strengths and weaknesses, they have the following ordered strengths in common [our position is given []]:

1. Strong discipline in their engineering and manufacturing processes with relatively few, and aimed at volume. [Poor, lots with incremental evolution and freedom to define alternatives vs. use standard.]
2. High degree of plant automation. IBM may have the best understanding of robots and Japan is clearly the supplier! Also increased focus on productivity. Intel may not have this. [Poor, no activity outside of test. No automated material flow. Lower productivity per person.]

2a. Focussed factories with combined manufacturing and engineering industry process engineering [good in semis, part of disks. Poor in terminals, systems, cabinets, and power supplies.]

3. Very good internal source of semiconductors; all but IBM supply externally. [We only make a few of our needs.]
4. Very good disks (except TI who's now trying). Not Intel! [Need better mid/high end.]
5. Basic understanding of all kinds of materials. [Little or no work.]
6. Very large research groups, except Intel. All receive government grants for research! [Weak.

External R+D to couple to.]

7. Aggressive engineering and product positioning. [Ok; many products.]
8. Strong emphasis on quality (here, I exlcude TI). [Ok; improving.]
9. Willingness to change and move rapidly whether it be product, pricing, or market method (e.g. channel of distribution) and manufacturing. [We're strong; getting older and conservative?]
10. Understanding of learning curves, market share and use of forward pricing (including IBM). [Ok; except too many products?]
11. Low inventories and willingness to drop products at end of life.
12. Significant worldwide engineering and manufacturing, especially Japan.

There are selective strengths and weaknesses(-) no particular order:

IBM

1. Very strong CAD/CAM tools and effort.
2. Disciplined processes and engineers who use a small number of PCB, Backplane, and common semiprocesses rather than evolving every possibility to get slight gains.
3. An incredible customer base and sales force capable of devouring most of any product.
4. Highly automated assembly lines with independent test and production flow controls.
5. (-)Many competing architectures and problems to evolve networks.
6. Applicators programming knowledge.

Japan

0. Best overall technology understanding of semis, magnetics, speech, video, robotics, and comm.
1. Ability to quickly assimulate products or processes from others.
2. Experience with low cost products like TV sets that will be model for terminals, small business system, etc.
3. Strong concern for standards as a way to the market.
4. Large population of engineers, including manufacturing engineers.
5. (-)Channel of distribution.
6. (-)Programming. This is immaterial since software will be done by U.S. SW engineers in U.S.!

TI

1. Semiconductor strength.

2. Good terminal and low cost product base.
3. (-)Programming.

Our Strengths

1. The best general architecture/product position potential.
2. Product lines to focus on various users and channels of distribution.
3. Rapid turn-around, dedication of individuals to their plans. (Are we getting older and more lithargic?)
4. Strong Systems Programming to orient to generic, profession and other applications.

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GB0005/24 (12/11/80)
GB2.S4.4 (3/17/81)

VIEW OF COMPETITORS

HOW CAN WE WIN AGAINST IBM?

IBM has or will have: both constant and a decreasing cost a 360/370 line new in the $100 K to $10 M price range with lots of plug compatible competitors, several operating systems to support, a large backlog; the 8100 for Distributed Processing around the mainframe; RPG-based System 32/34/38 for Distributed Processing and as a Mainframe for small organizations; the aging Systems 3 to 15 for Distributed Processing; the System 1 for the would-be minicomputer buyer; the possibly defunct 5100-series Personal Computers for the scientist, engineer, analyst and small business; [the WPS computer] and several inevitable personal computer. All of these are incompatible, except for the fact that they speak some dialect of SNA and language standards. Products are relatively segmented to customer classes and different languages are used to enforce segmentation and hinder application mobility. Finally, they've sold via DPD, GSD, and Office Products.

The 8100 was a radical departure from IBM pricing as 0.5 Megabytes of primary memory and a 60 Megabyte disk are $ 29 K. Memories on all machines are similarly priced. We repriced as a result. The 8100 is exactly in the price range of the systems we sell and where we make most of our revenue. It is the second product in this price range within a year; the Series 1 minicomputer family patterned after the 11/04-11/34 was the first product. The 370 (via the 43xx series) is clearly either in or is coming into our space this go-around or next generation (1984). On the surface, the product is low priced, with lots of capability, but it also has a new communications structure (versus the one we have used substantially unchanged since 1961). This structure permits easy peripheral and terminal interfacing for both the office and factory environment. There is an extensive range of peripherals, terminals and communications to the 360/370. Since the product is sold by DPD, the strategy seems to keep account control and to make the money on software and the numerous locked-in, generally overpriced hard to emulate terminals.

SNA seems finally under control and we must be concerned because it has future built-in capability (e.g. word processing, typesetting, packetized voice). Their strategy seems to be to slowly unfold it, make it the standard, pay no attention to other standards and to make everyone follow their gyrations. A strategy based on being tightly coupled to them (e.g. with terminal emulation or fully compatible across the board) is really risky. We must interface to them "carefully" and be very, very aggressive in our own interconnect plans (both in performance and capabilities). We must collaborate with ATT and the international standards community to set standards.

We must watch how the System 38 is used vis a vis its 48-bit address because it can lock us out and cause others to generate many dead end architectures. It may be a E/H series follow-on breadboard.

HOW CAN WE WIN AGAINST OTHER COMPETITION?
There are established competitors too, such as DG, HP and Prime. DG and Prime have very simple, single architectures and have been most profitable and have grown most rapidly. HP is converging on a single architecture around the 3000, but it will have to be extended eventually. [The NOVA has been extended.] The large manufacturers (Univac, Honeywell and Burroughs) which operate with an established base are less profitable, have grown slowly and have multiple, poor architectures. Honeywell, with a simple, but adequate minicomputer architecture seems to be doing well by selling minis to its old line, mainframe base. There is no evidence that they're developing or pursuing the mainframe business actively.

There are probably more significant threats from the companies that can be easily founded to build systems into OEM Winchester disks by using the newly announced zero-processor-cost, microprocessors which have 22-bit address spaces and >11/45 performance. These architectures [are already] extended for multiprogramming and to handle larger virtual memories, but many point products, such as RSTS, can be built easily and cheaply and can quite possibly target a specific existing, trained user base. [UNIX could well be the standard that carries interactive computing in the 80s!]

There are also the Japanese and TI which can be lumped together because of their similar behavior. Both believe in targeted, high-volume products with forward pricing. Neither have an adequate architecture. TI is strictly limited to 16-bits with almost no escape and [except a new architecture ala VAX] the Japanese are aimed at the 360/370 using U.S. companies (e.g. Service Bureaus) to distribute hardware, <u>and</u> at high volume point products that will go into stores, no doubt.

[The strategy requires very high volumes for dumb terminals, evolving to down line loadable terminals for specific applications like TP.] [The market is requiring and evolving to programmable (intelligent) terminals [i.e. Personal Computers], and this requires using the 11 until VAX is appropriate in terms of price.] [The goal is PC-VAX with terminal, 5-10Mbytes of secondary memory, 512Kbytes of primary memory, processor, and NI connection.] In the mid and high priced minis, the strategy is compatibility and volume, phasing as appropriate from 11 to VAX [as dictated mostly by mass storage and customer need for VAX. We must recognize that virtually every application will evolve to outgrow the 11 and hence we should try to get our users to VAX ASAP, because the longer one can procrastinate a change, the more competitive the offerings will be!] For example, since there is not a high priced 11 after the 11/70 and the 11/44, there is a phasing to VAX (through Nebula).

GB2.S3.32

THE TELECOMMUNICATIONS ENVIRONMENT

A new industry is being formed from the joining of data processing, communications and office automation.

1. **"SERVICE"** - The front line of this industry is in providing information services - a data utility. The publishing and TV industries know how to package information. The telecommunications equipment suppliers know how to transmit and switch it. The service bureaus know how to process it. The common carriers know how to manage the transmission network that ties all this together.

   Our value added must be in our ability to store data cost-effectively and retrieve it flexibly along lines of access natural to untrained users.

2. **"HUMANISTIC"** - The crucially important part of this industry is its interface to workers whose job is the collection, rearrangement, and dissemination of data in ways that provide for better decisions. Vehicles for providing these services are (communicating) small business computers and office data management systems or pre-processing terminals off-loading central equipment.

   Our value added is in providing the most natural, most powerful methods to enhance the effectiveness of this work. Although productivity is key, there has been historical reluctance to capitalize such work and since this will remain a competitive field, cost of the tool providing such methods will continue to play an important part in purchase decisions.

3. **"CENTRALIZATION"** - The center of this industry will be the data switching and transmission network. Seeking incremental revenue on already committed capital equipment, the common carriers will press to extend their sphere of services. The PTT's will use the force of government regulations to assure their control of this sphere.

In such a situation, customer data storage and processing will be part of central office functions (hiearchically decentralized as needed to the customer site PABX's leased from the carrier). The common carriers will look to long established suppliers of central office equipment (for AT&T, there is Western Electric) to enhance their products to support this direction. These suppliers then will govern the market for computer equipment.

Our value added is on supplying a compatible line of processing equipment from chips (used directly in switching and transmission control) to very high availability shared central computer facilities. To generate revenue we will need to nurture our relationships with the dominant telecommunications equipment suppliers (Siemens, NEC, Western Electric, L.M. Erickson,...) and make a convincing case for them to buy ours rather than make their own computing equipment.

4. **"DIVERSITY"** - The breadth of opportunities available in this will favor start-up operations with novel approaches to previously latent demands. Private local, as well as independent city-wide cellular and global satellite communications networks will be an alternate to the previously establlished transmission monopolies. The regulating authorities will take the postion that competition will provide the most effective use of the available resources. Corporate headquarter operations will seek alternative forms of information services to avoid too close an embrace with any one vendor and to foster innovation through experimentation with novel approaches to the information problem.

   In this environment, our value added can be in providing the standards and critical components that allow special purpose equipment of many varieties supplied by many vendors to interact effectively. Many of the standards will take the form of open system network specifications at national or global levels and local area interconnects in more restricted geographies.

Our experience in distributed processing will allow us to establish a lead good enough for others to follow. Our indirect channels permit us to foster others innovation built on our standards and component pieces. Users seeking freedom from bureaucratic central data processing managers can get their needs satisfied with our equipment.

We offer an alternative to the single vendor approach supported by IBM.

COMPETITIVE TECHNOLOGY DIRECTIONS

Bruce Delagi has constructed a simplified taxonomy of technologies which are relevant to Digital. This section contains descriptions of the twenty (20) major categories which were identified, followed by a graphic plotting of Bruce's sense of where DEC and some of its competitors have their strengths. The arrows indicate the directions in which Bruce sees the different companies moving. He concludes that Man-Machine Interfaces represent the greatest strategic opportunity for DEC.

SEMI/SUPERCONDUCTING MATERIALS

- Crystal/epitaxial/thin film growth
- Doping, vapar deposition, metalization
- Junctions & interfaces; oxide films

- lithography, ion-implant,
- low energy chemistries; GaAs
- composite superconductors;
- ferro-electric semiconductors;
- Josephson effects; SQUID
- amorphous/liquid/organic semiconductors

CIRCUIT DESIGN AND FABRICATION

- Logic design & modelling; circuit analysis
- Computer-aided logic design
- Printed circuit layout/design/mfgr.
- Thin/thick film, hybrid circuits
- Microassembly

- Chip carriers, FTA chips/modules, N/C milling
- CAD, logic design, discrete simulation
- PCB design, analog PCB, other PI layout
- VLSI layout; Silicon structures
- Solder bumps; thin film deposition
- Multilayer/controlled impedance PCB's
- Master(slice); cell circuit models

STORAGE MATERIALS AND DEVICES

- Oxides Ferrites & Garnets; Magnetic Matl's
- Magnetic Tapes, Disks, Recording Heads
- Magneto-acoustic/magneto-strictive devices
- Magnetic thin film/magneto-optical devices
- Semiconductor storage; magnetic cores
- Magnetic bubble domain devices
- Amplifiers & signal generators

- Memories; magnetic heads and media
- Magnetic epitaxy

FILTERS, MODULATORS AND SIGNALS

- Modulators, demodulators, discriminators
- Mixers and modulation methods
- Digital filtering/conditioning/detection

- Digital filters; modem design
- Pulse code modulation

WAVEGUIDES, XMISSION LINES, FIBER OPT

- Waveguides/strip lines/coax cable
- Transmission line links & equipment
- Transmission line theory
- Microwave circuits & devices
- Optical links & equipment
- Optical waveguides & fiber optics

- Cable systems, multidrop optics
- Optical fibers/couplers

COMMUNICATION LINKS

- Frequency Allocation/Spectrum Pollution
- Mobile/point-to-point radio systems
- Satellite relay/space communication
- EM wave propogation; antenna theory
- Antenna arrays; radio links & equipment

- High speed lines?; satellite links/relays
- Cellular radios; Satellite Business Systems
- Communications legislation/(de)regulation

OPTICAL COMPONENTS

- Electrobeam scanned/solid state tubes (incl crt's & vidicons)
- Electroluminscent/liquid crystal devices
- Phosphors, LED's, Photodetectors
- Integrated optics, solid lasers
- Semiconductor junction lasers
- Optoelectronic matl's & devices
- Electro-optical, accusto-optical devices

- Plasmas, crt's, lcd's, ccd's
- Surface acoustic wave devices

CODING, DIGITAL SIG. PROD, INFO. THEORY

- Codes, information theory
- Digital signal processing
- Simulation, Modeling & Identification
- OR & Combinatorial Mathematics

- Information theory, encryption
- Correction codes; data compression

SEMI/SUPERCONDUCTOR DEV'S & CKTS.

- Device (product) packaging
- Bulk effect/field effect devices/circuits
- Coupled superconducting devices
- Logic & switching elements

- Gate arrays, VLSI-MOS, ECL, I^2L, I^3L
- Heat transfer; lead bonding
- Cellular arrays; PLA, MESFET

PROCESSING EQUIPMENT

- Computer architecture; automata theory
- Analog & digital computer/systems
- Combinatorial/sequential switching/logic
- Systems reliability; EMI/RFI
- Digital arithmetic methods
- Power systems & other digital circuits

- Backplanes, power supplies mech. packaging
- Microprogrammed/(multi)processor architecture (Data flow) parallel processors
- Processor arrays, (pipeline) array processors
- Architecture specification/verification
- RAMP, non-stop; self-check; fault-tolerance
- Systems design; environment/EMI/acoustic test

STORAGE EQUIPMENT AND TECHNIQUES

- Storage on magnetic media
- Magnetic (analog) storage equipment
- Video recording; holography

- Control theory, magentic simulations
- Finite element/difference analysis
- Parallel access storage structures
- Associative content-addressable storage

FILE SYSTEMS AND DATABASE MANAGEMENT

- Database management system
- File organization

- (Relational) file systems, content analysis
- Distributed text/image/voice/data management
- Data integrity, audit, privacy, authentication
- Computer crime, vulnerability/security
- Storage (hierarchy) management; caches
- Information/data structures, access methods

TELEPHONY AND SWITCHING SYSTEMS

- Telephony; switching centers & equipment
- Integrated switching/transmission systems
- Other telephone exchanges
- Other switching centers

- Digital & voice switching; telephony
- Time/frequency division multiplexor
- Central office switching, PABX's, CBX's
- Store-and-forward voice

DATA TRANSMISSION AND NETWORKS

- Data transmission; computer communication
- Communications switching theory; networks
- Data communication equipment & techniques

- Network analysis and test; networking
- Distributed systems; distributed OS
- Open systems architecture; public nets
- Local area nets; packet switching
- SNA, DNA, DCNA, ACS, X.25, EURONET
- Transborder data flow

SPEECH AND IMAGE PROCESSING

- Speech intelligibility (incl synthesis)
- Pattern recognition
- Optical information processing

- Voice/image recognition/synthesis
- Voice/image coding; picture processing
- Spatial filters; OCR; speech, vocoders
- Feature extraction, discrimination
- Handwriting, handprinted, Kanji

I/O TERMINALS AND IMAGE SENSING

- Display and image sensing systems
- Pattern recognition equipment
- Printing and associated industries
- Graphic displays and interactive terminals
- Printers, punched card, punched tape
- COM, TV receivers, telephones
- Display technologies

- Keyboards, touch inputs; magnetic printing
- (non-) impact printing; paper handling
- Graphics; inkjets, xerographics
- Laser scanners, cameras, facsimile
- Reprographics, text setting, typesetting

OPERATING SYSTEMS AND LANGUAGES

- Computer metatheory and formal logic
- Programming languages/algorithm theory
- Software techniques and systems
- Diagnostics, testing, debugging, evaluation
- Operating systems; queueing theory

- Certification/secure OS; valid/verification
- Firmware, microprogramming; assertion testing
- System verification/performance analysis/sim.
- Language/compiler design; software methodology
- Reliability/recovery/availability/checkpointing
- Realtime (?), scheduling, allocation, exclusion
- Concurrancy, deadlock, synchronization

RETRIEVAL APPLICATIONS

- Information science and documentation
- Publishing and Reproduction
- Generation dissemination information use
- Information analysis and indexing
- Bibliographic systems

- Self help, manuals, documentation
- Materials (information) management
- (Non-procedural) (query) lanugages

TELECOMMUNICATION SERVICES

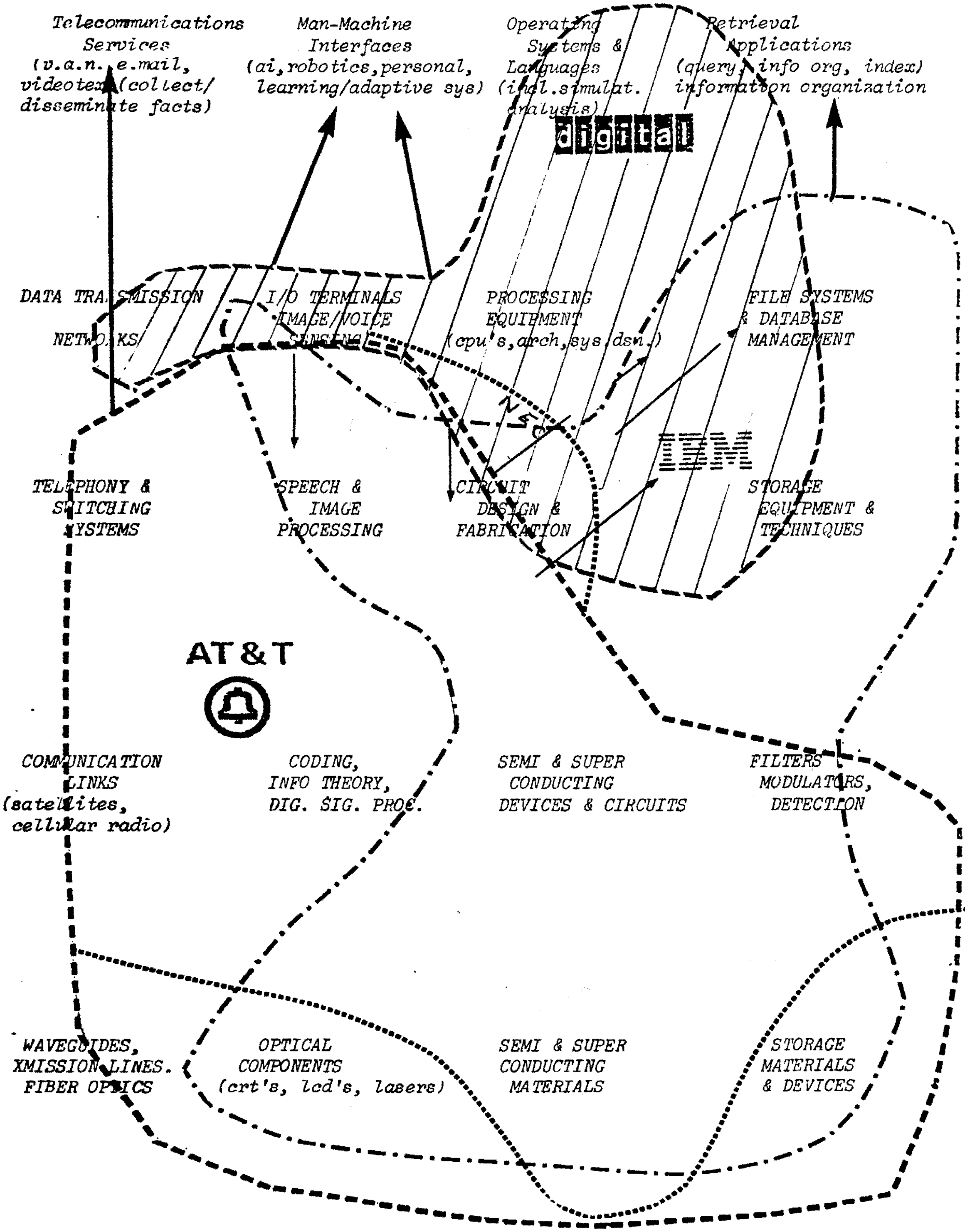
- TV system and telecommunication applications
- CATV, closed circuit TV, wired systems
- Telegraphy and facsimile transmission

- Value-added networks, telefax, teletex
- Teleconferencing; electronic mail, teletext
- Bildschirmtext, Viewdata, Antiope
- Cableware, DataVision, Prestel, Telidon

MAN-MACHINE INTERFACES AND IMAGING APPLICATIONS

- Man-machine systems
- Artificial intelligence
- Radar theory, optical radar
- Data handling techniques
- Biomedical measurement and imaging

- Automation, artificial intelligence, robotics
- Productivity; customization; personal computing
- Cognitive factors; problem-solving; non-expert
- Physical ergonomics; industrial design
- Learning and adaptive systems; heuristic methods
- Induction/hypothesis-formation; non-procedural
- Automatic assembly/inspection


Telecommunications Services (v.a.n., e.mail, videotex (collect/ disseminate facts)
Man-Machine Interfaces (ai, robotics, personal, learning/adaptive sys)
Operating Systems & Languages (incl.simulat. analysis)
Retrieval Applications (query, info org, index) information organization
digital
DATA TRANSMISSION NETWORKS
I/O TERMINALS IMAGE/VOICE SENSING
PROCESSING EQUIPMENT (cpu's, arch, sys dsn.)
FILE SYSTEMS & DATABASE MANAGEMENT
NEC
IBM
TELEPHONY & SWITCHING SYSTEMS
SPEECH & IMAGE PROCESSING
CIRCUIT DESIGN & FABRICATION
STORAGE EQUIPMENT & TECHNIQUES
AT&T
COMMUNICATION LINKS (satellites, cellular radio)
CODING, INFO THEORY, DIG. SIG. PROC.
SEMI & SUPER CONDUCTING DEVICES & CIRCUITS
FILTERS MODULATORS, DETECTION
WAVEGUIDES, XMISSION LINES. FIBER OPTICS
OPTICAL COMPONENTS (crt's, lcd's, lasers)
SEMI & SUPER CONDUCTING MATERIALS
STORAGE MATERIALS & DEVICES

CHAPTER IV

QUANTITATIVE MEASURES

A) DIGITAL'S ENGINEERING INVESTMENT
   1) LRP Numbers and Engineering Budget
   2) Competitive Engineering Investment (no lag, 2 yr. lag, Growth to investment correlation chart)

B) PRODUCT POSITIONING
   1) Benchmark Systems Price Decline Chart (1945-2000)
   2) Digital Price Band Positioning FY78-85 (Overview, 12-Bit, Terminals/Tabletop, 16-Bit Q-Bus, 16-Bit U-Bus, 32-Bit, 36-Bit, Disks)

C) CENTRAL ENGINEERING BUDGET OVERVIEW - FY80-84
   - Expense by OOD Group ($, %)
   - Expense by Program ($, %)

D) TESTS OF BUDGET ALLOCATION
   1) Digital Revenue - NOR to 86 by Architecture
      - NES to 86 by System
      - NES by Price Band - FY80 to 86
   2) Digital 82 spending vs 85 Revenue - By Price Band (Commentary)
   3) Market Size - U.S. NOR by Price Band 79, 85
      - U.S. NOR by Price Band/Competitor 79, 85

E) PRODUCT FINANCIAL METRICS
   - Years to Breakeven
   - NOR vs IRR (Systems, Terminals, Storage)

F) PG ENGINEERING EXPENDITURES - FY82

A) DIGITAL'S ENGINEERING INVESTMENT

LRP NUMBERS

	ACT 80	EST 81	LRP 82	LRP 83	LRP 84	LRP 85
MLP ($B)	2.2	2.9	4.1	5.6	7.4	10.0
NES ($B)	1.8	2.3	3.4	4.5	6.0	8.0
NOR ($B)	2.4	3.2	4.5	6.1	8.1	10.8
CENTRAL ENGINEERING ($M)	133	179	245	333	446	597
% NOR	5.6%	5.6%	5.5%	5.5%	5.5%	5.5%
P/L ENGINEERING ($M)	45	58	78	106	136	170
MANUFACTURING ENGINEERING ($M)	9	16	22	36	49	65
ALL ENGINEERING % NOR	7.9	7.9	7.8	7.8	7.8	7.7

Observation: Central and P/L Engineering are expected to maintain their historical spending proportions of NOR.

Source: Jan 81 Corporate LRP

D. CLINTON
3/17/81

A) DIGITAL'S ENGINEERING INVESTMENT

¦COMPETITIVE¦
¦ENGINEERING¦
¦INVESTMENT¦
¦NO LAG¦

Key Competitors in Box

	ENG EXPENDITURES AS % OF NOR
ALL U.S. INDUSTRY	1 1/2%
ELECTRONICS INDUSTRY	3%
COMPUTER INDUSTRY	6 1/2%

	ENG EXP AS A % OF NOR	EST ENG FY82 ($ MILLIONS)	APPX ANNUAL SALES GROWTH OVER PAST 5 YRS
¦INTEL¦	11 %	$ 160	39 %
¦FUJITSU¦	11	290	15
DG	10 *	125 *	38
¦HP¦	9	450	29
DATAPOINT	9	60	45
TANDEM	8	25	358
¦DEC	8	345 ?	34 ¦
PRIME	8	50	91
¦WANG¦	7	90	54
BURROUGHS	6	235	14
¦IBM¦	6	1815	12
NCR	6	220	10
XEROX	5	525	14
SONY	5	310	18
NEC	5	260	13
TI	4	230	24
HITACHI	4	635	13
TOSHIBA	4	405	12
AT&T	1	480 **	12

OBSERVATIONS:

1) GROWTH RATES SHOW POSITIVE CORRELATION WITH ENGINEERING % NOR.
2) IBM'S DOLLAR INVESTMENT IS OVERWHELMING.

*D.G.: "REAL" INVESTMENT IS CLOSER TO 7 1/2% AND $95M FOR FY82 (Annual Report probably overstates R&D exp.)

**AT&T: $480 IS THE 82 EST FOR BELL LABS PURE R&D. LABS WILL SPEND ANOTHER $600M FOR PRODUCTS TO BE SUPPLIED TO WESTERN ELECTRIC.

SOURCE: FY79 OR FY80 ANNUAL REPORTS OR 10K

D. CLINTON

A) DIGITAL'S ENGINEERING INVESTMENT

COMPETITIVE ENGINEERING INVESTMENT
--2 YEAR LAG--

Key Competitors in Box

	ENG % NOR (2 YEAR LAG)	EST/REAL ENG EXP 3 YEARS 1979-1981 ($ MILLION)	EST NOR 3 YEARS 1981-1983 ($ BILLION)
FUJITSU	8.4%	$670	$ 8.0
INTEL	5.8	300	5.2
DG	5.8*	210 *	3.6
HP	5.2	830	15.8
IBM	4.7	4600	97.3
DEC	4.2	575	13.6
NEC	3.8	595	15.5
PRIME	3.0	62	2.1
HITACHI	2.9	1475	51.6
WANG	2.7	110	4.1

Observation: Digital is toward the lower end of the acceptable range of Engineering Investment.

*D.G.: "Real investment is probably $160M or 4.4%.

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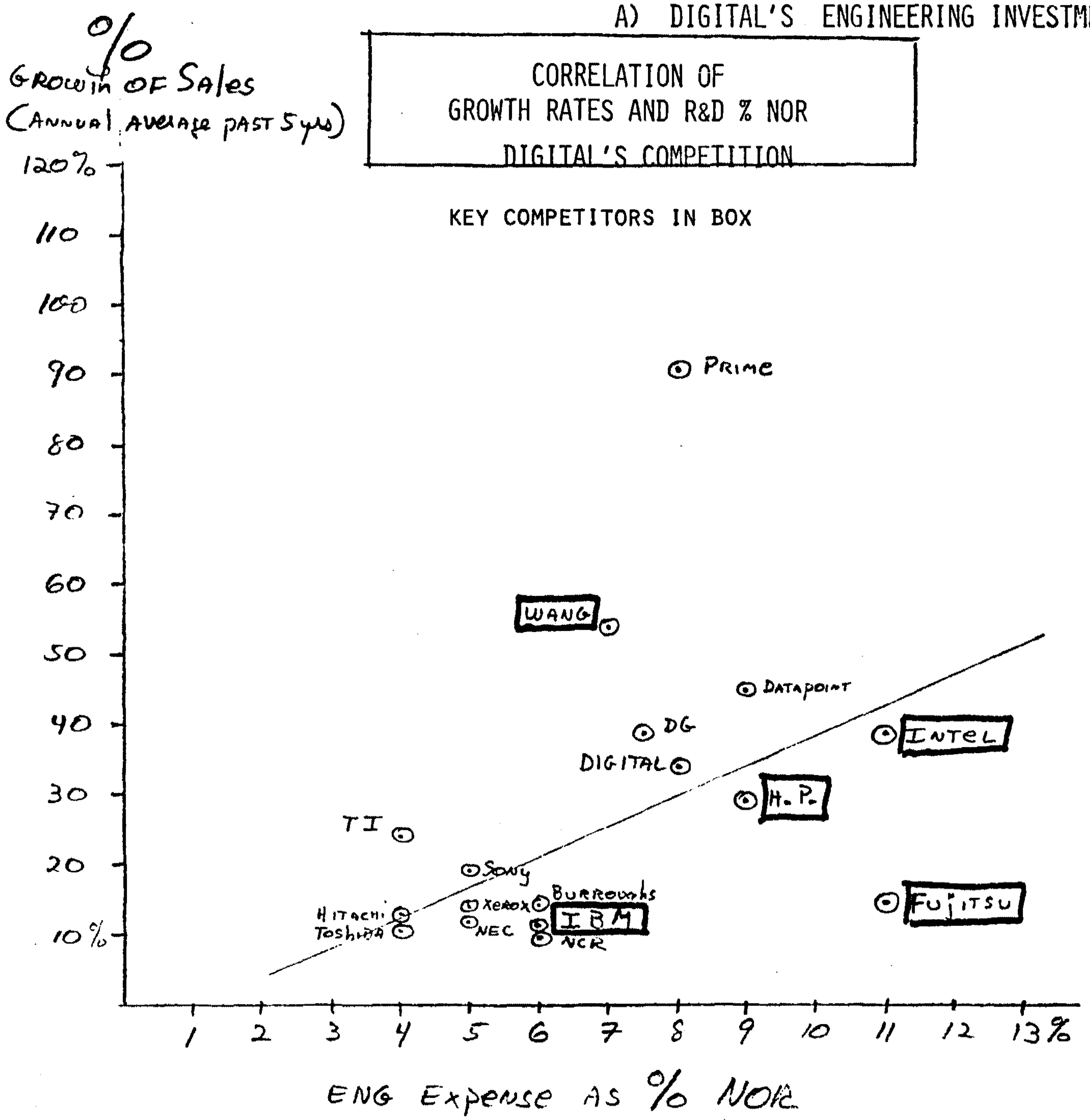
3/3/81

A) DIGITAL'S ENGINEERING INVESTMENT



OBSERVATIONS:

1) FOR THE COMPUTER INDUSTRY, THERE IS A POSITIVE CORRELATION (.47) BETWEEN GROWTH AND SIZE OF R&D INVESTMENT.
2) OF THE COMPETITORS ABOVE THE TREND LINE, WANG AND PRIME HAVE VERY FOCUSED PRODUCT OFFERINGS. IN CONTRAST, IBM AND FUJITSU, ALTHOUGH MUCH LARGER, HAVE PRODUCTS ACROSS A VERY BROAD RANGE. CLEAR PRODUCT FOCUS MAY CORRELATE WITH HIGHER GROWTH.

SOURCE: CORPORATE ANNUAL REPORTS

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3/17/81

PRODUCT POSITIONING COMMENTARY

The following charts show price band positioning by architecture.

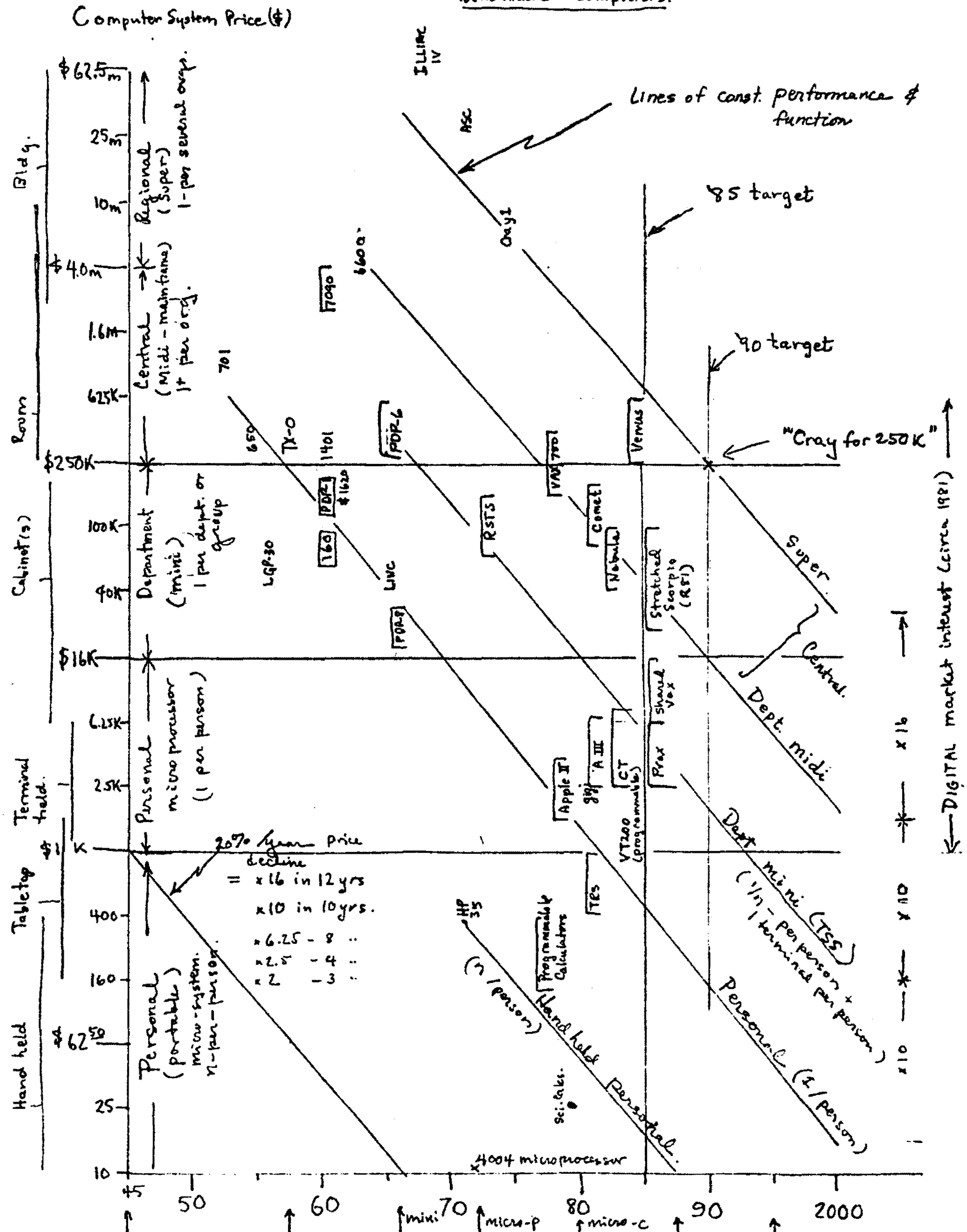
These charts indicate the simplification overtime of the currently overlapping family of products. 36-Bit will show increasing focus into the greater than $625K price band. The 32-Bit family extends to cover the range from $625K to slightly less than $40K. (Scorpio systems-beyond FY85-will dramatically extend the 32-Bit range downward.)

Unibus-11 Systems show a narrowing of the range, and are completely overlapped by 32-Bit systems. Unibus-11 will probably be sold primarily to existing 16-Bit customers.

Q-Bus 11 Systems cover the $16K - $40K band until Scorpio is available.

New tabletop products (CT) will be a dramatic entry below the $6.25K price barrier.

Fig. GC Computer System Price Versus Time for Various Benchmark Computers.



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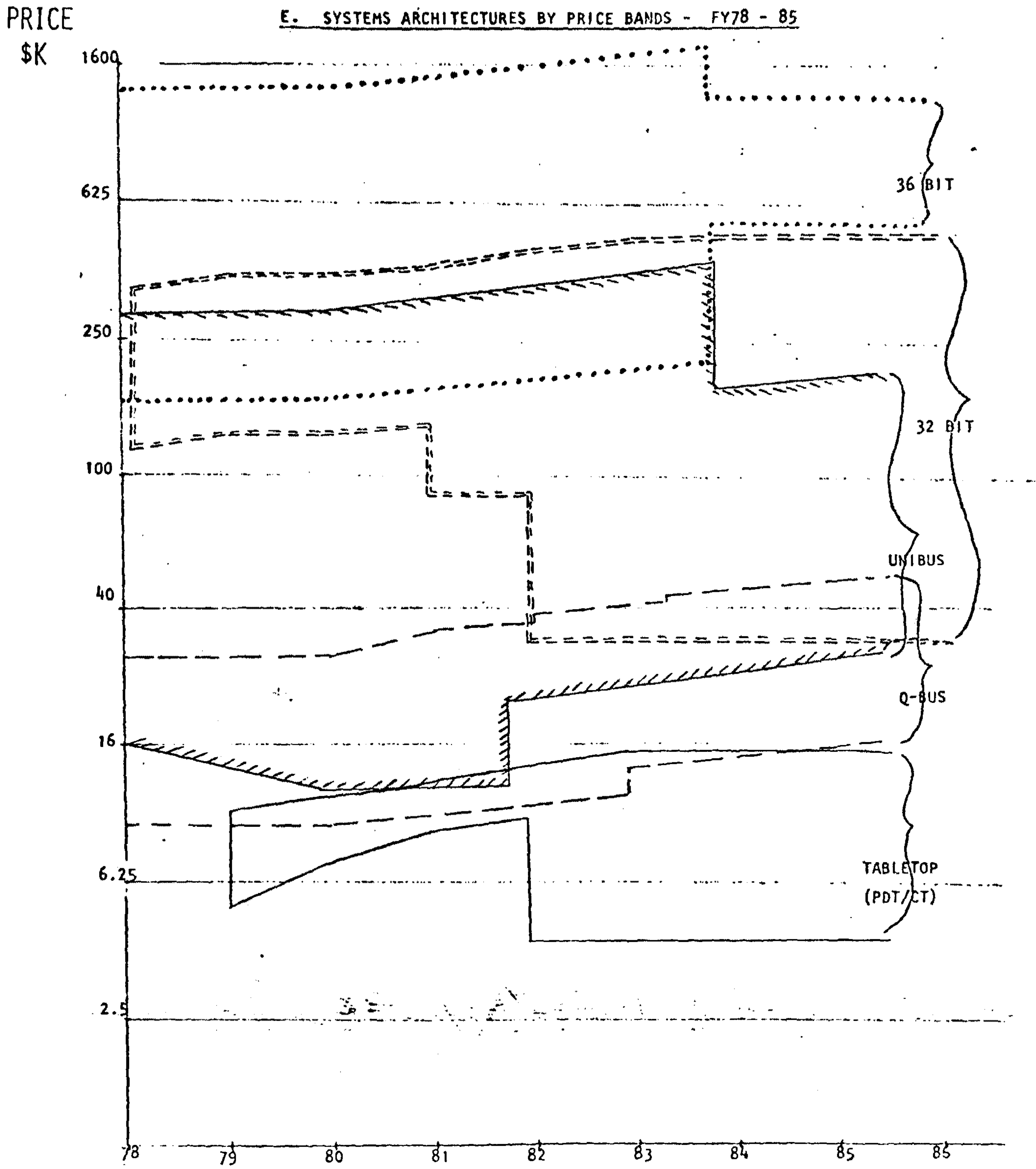
B) PRODUCT POSITIONING

DIGITAL ARCHITECTURE OVERVIEW



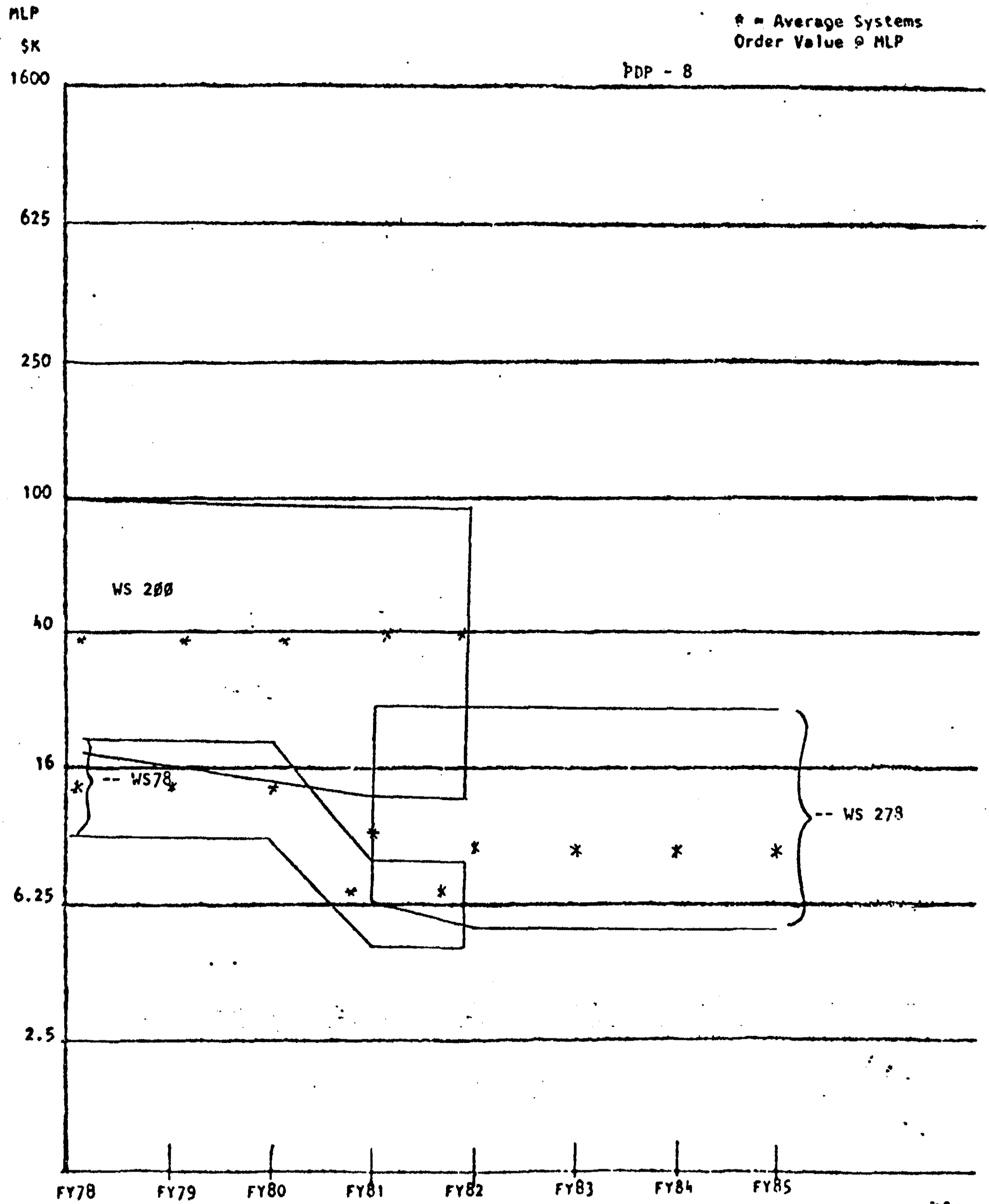
V.E./

Company Confidential

B) PRODUCT POSITIONING

- 12-BIT

E. SYSTEM PRICE BANDS: FY'78 to FY'85



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V.E.7

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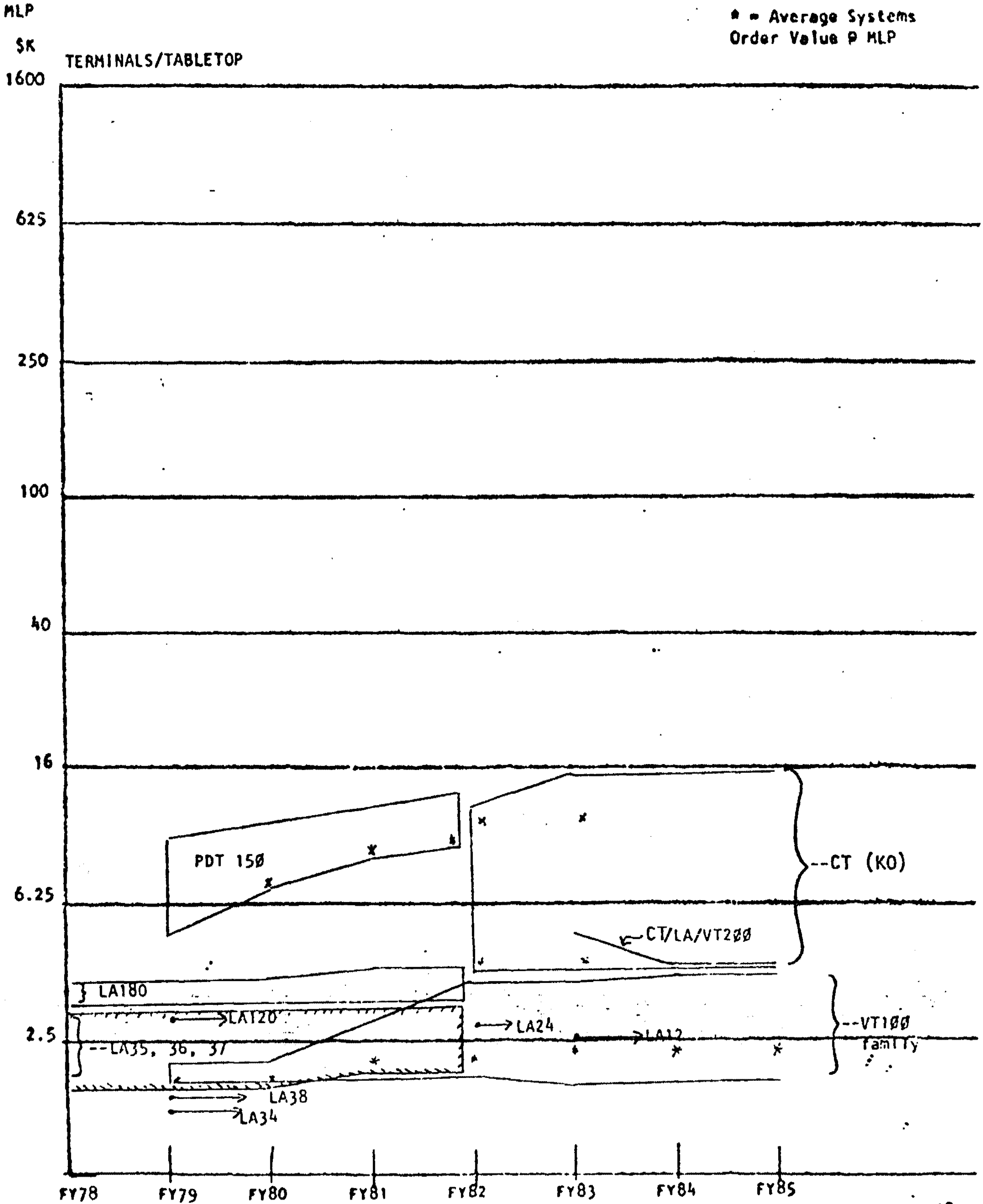
E. SYSTEM PRICE BANDS: FY'78 to FY'85



JS 11/7/80

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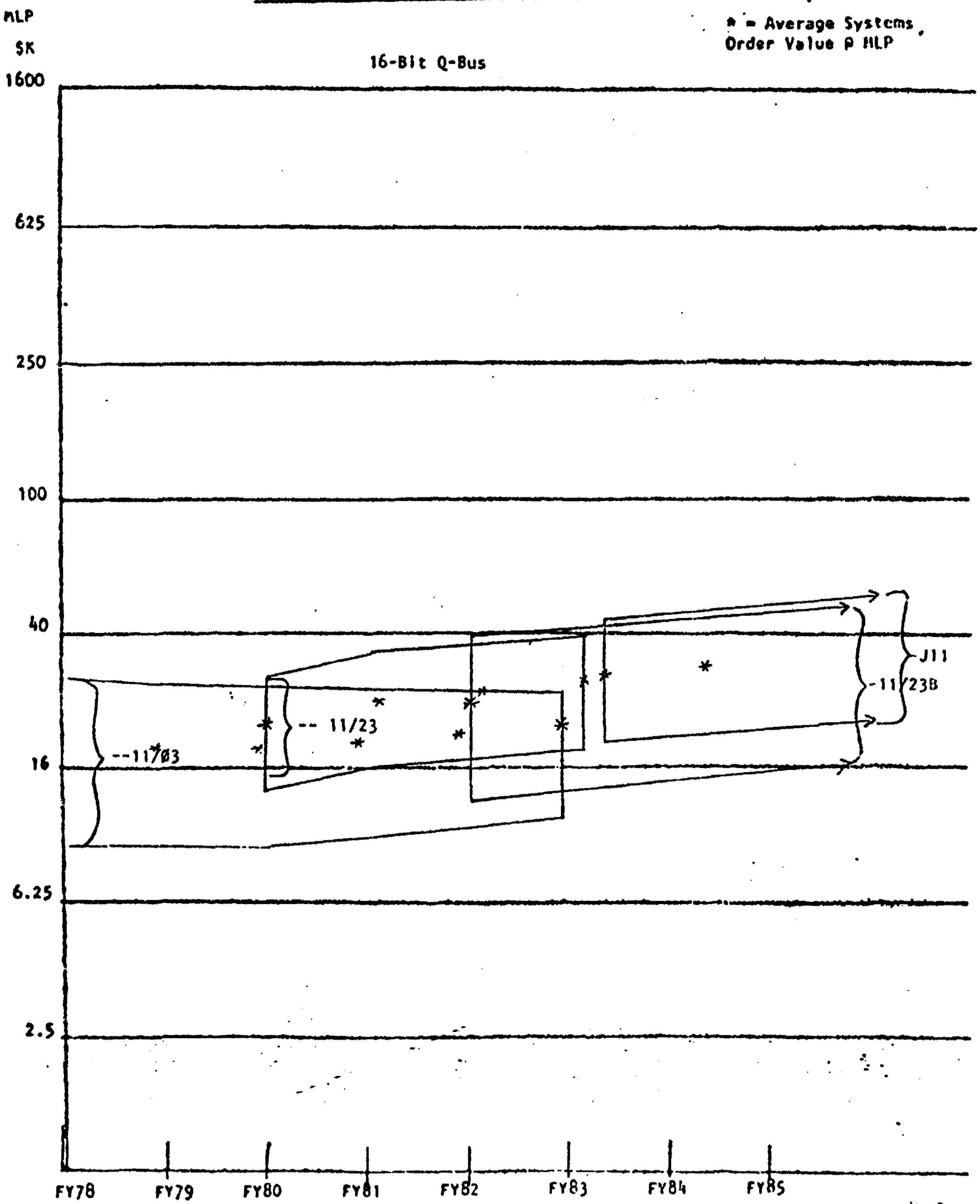
B) PRODUCT POSITIONING

- 16-BIT Q-BUS

E. SYSTEM PRICE BANDS: FY'78 to FY'85



JS 11/7/80

V.E.4

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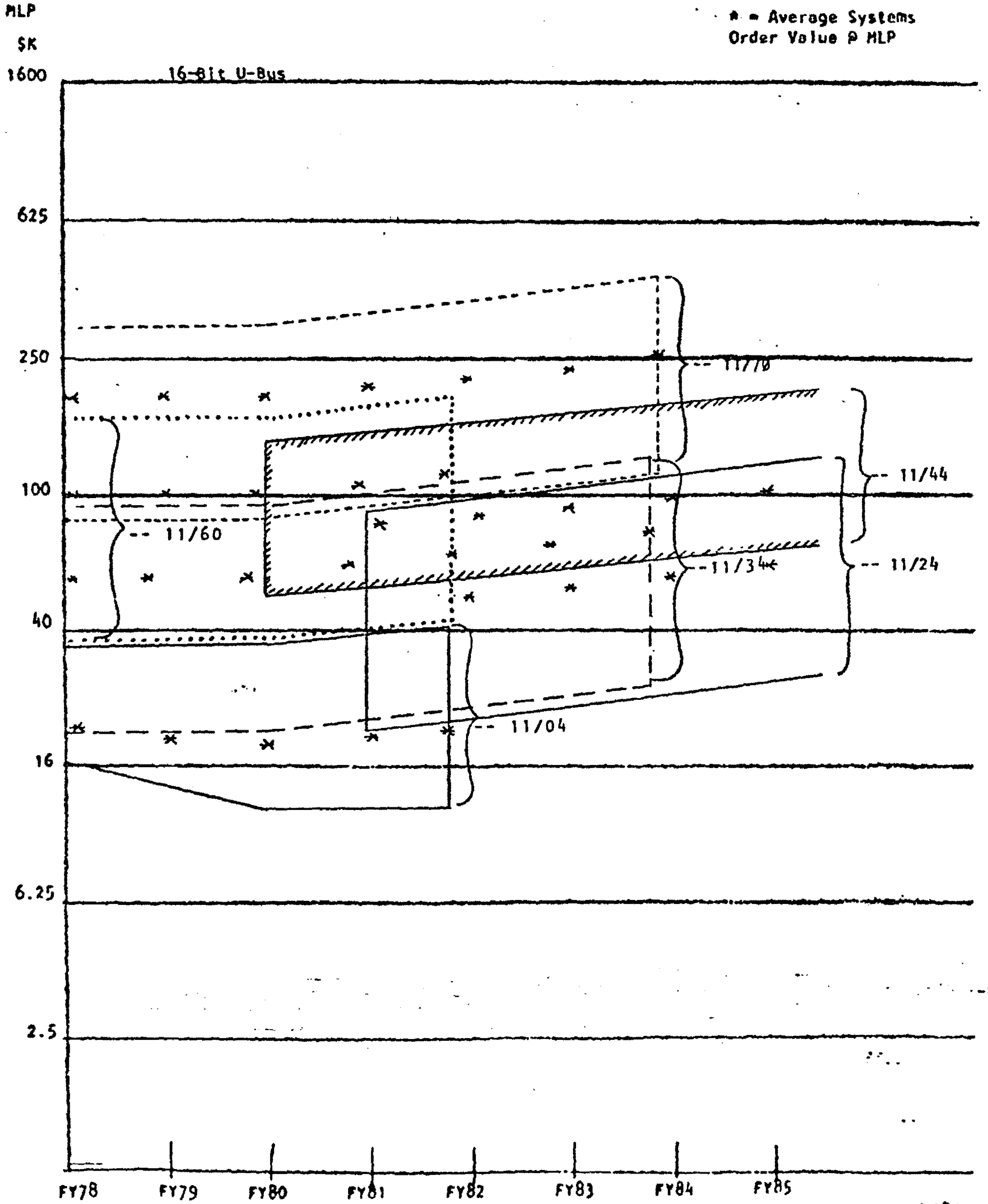
E. SYSTEM PRICE BANDS: FY'78 to FY'85



JS 11/7/80

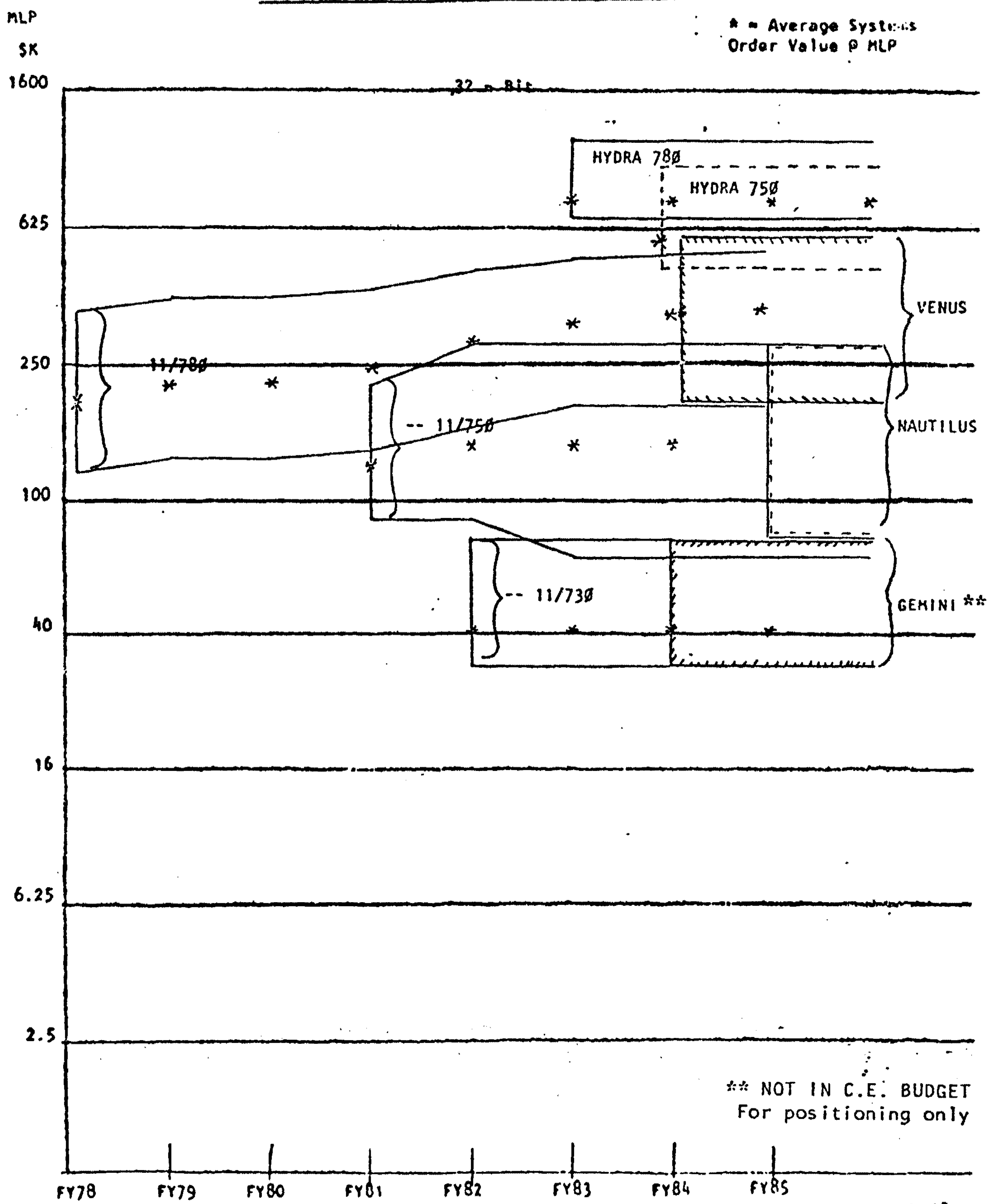
V.E.3

Company

B) PRODUCT POSITIONING

- 32-BIT

E. SYSTEM PRICE BANDS: FY'78 to FY'85



JS 11/7/80

V.E.5

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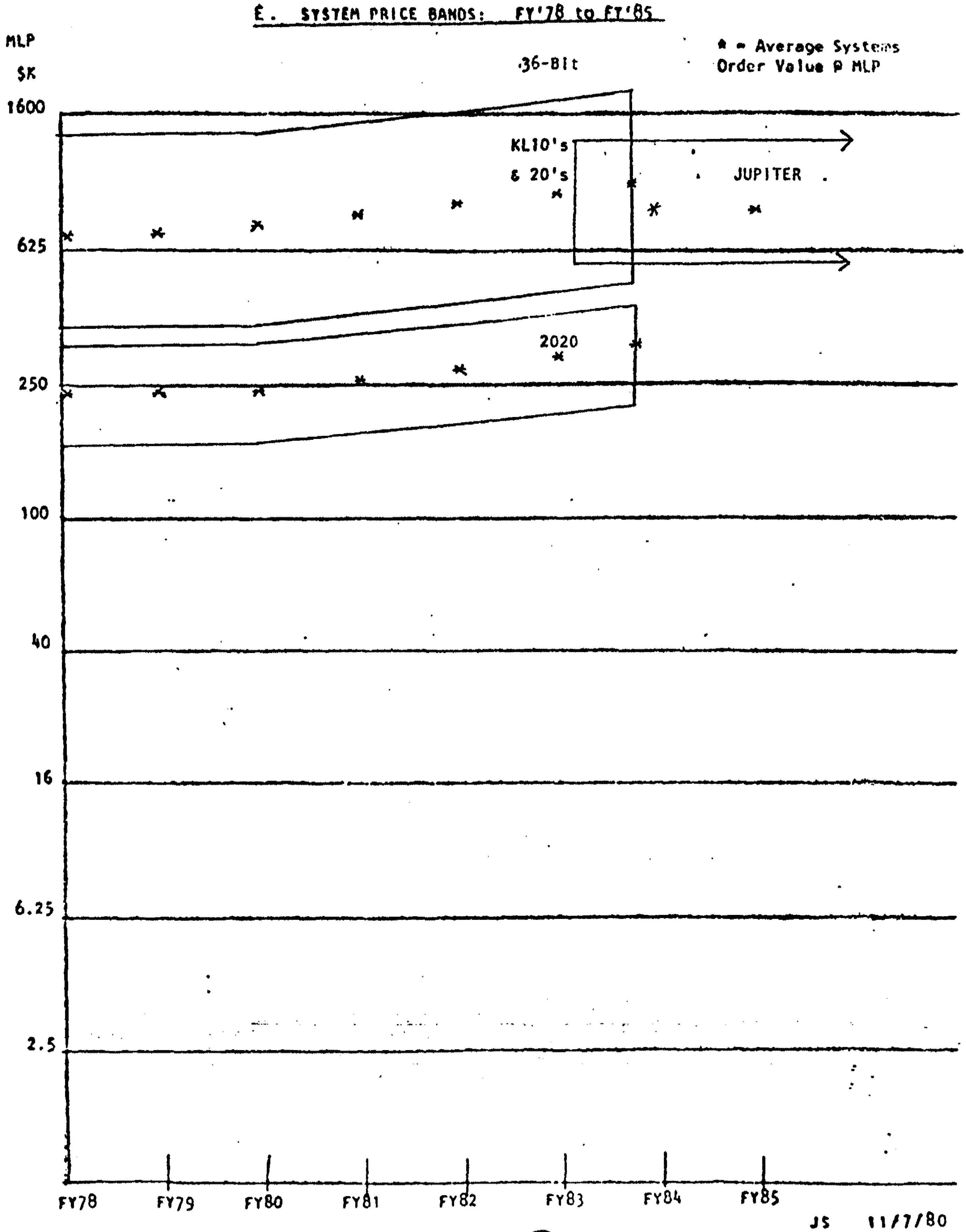

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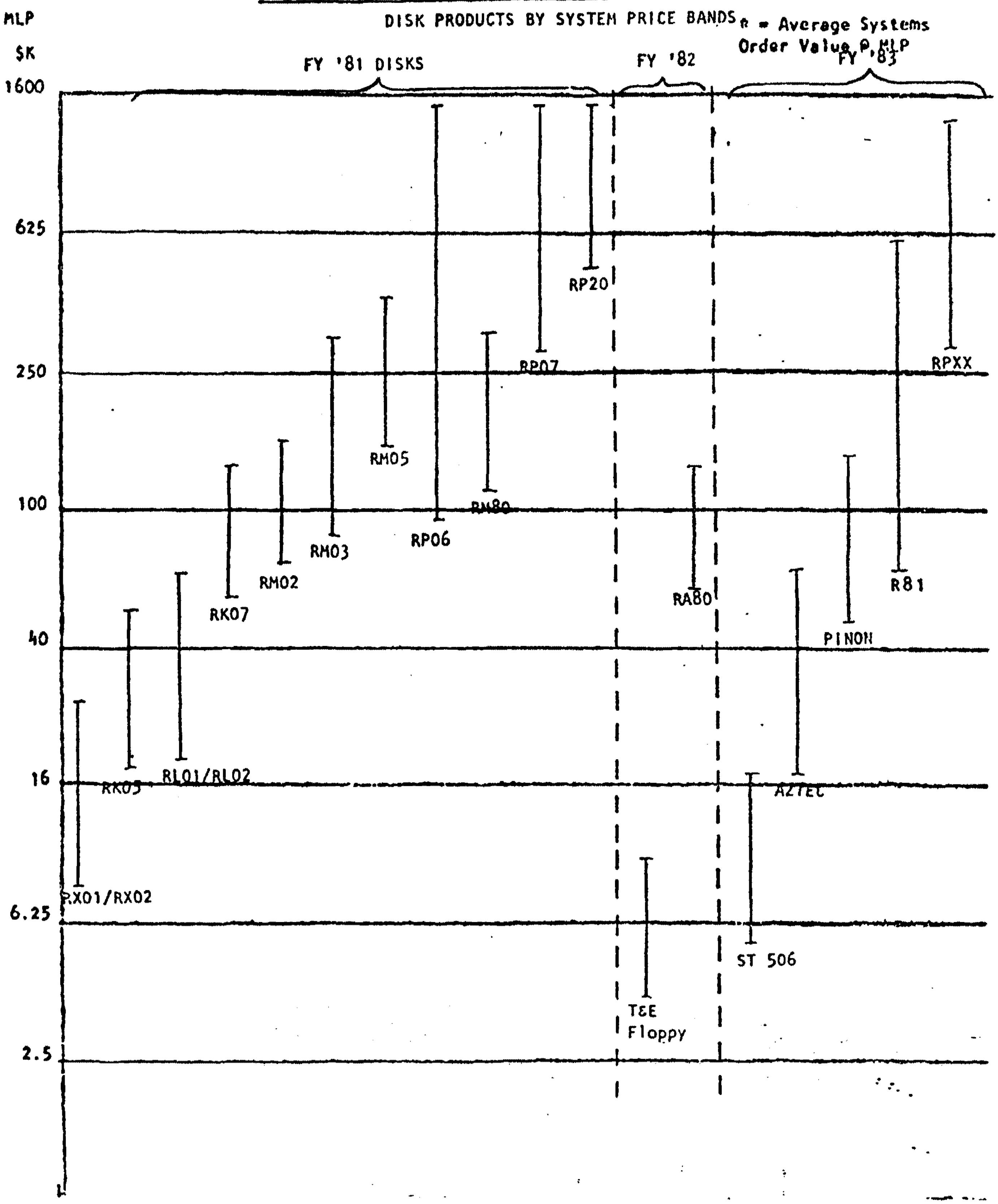
B) PRODUCT POSITIONING

- DISKS

E. SYSTEM PRICE BANDS: FY'78 to FY'85

DISK PRODUCTS BY SYSTEM PRICE BANDS

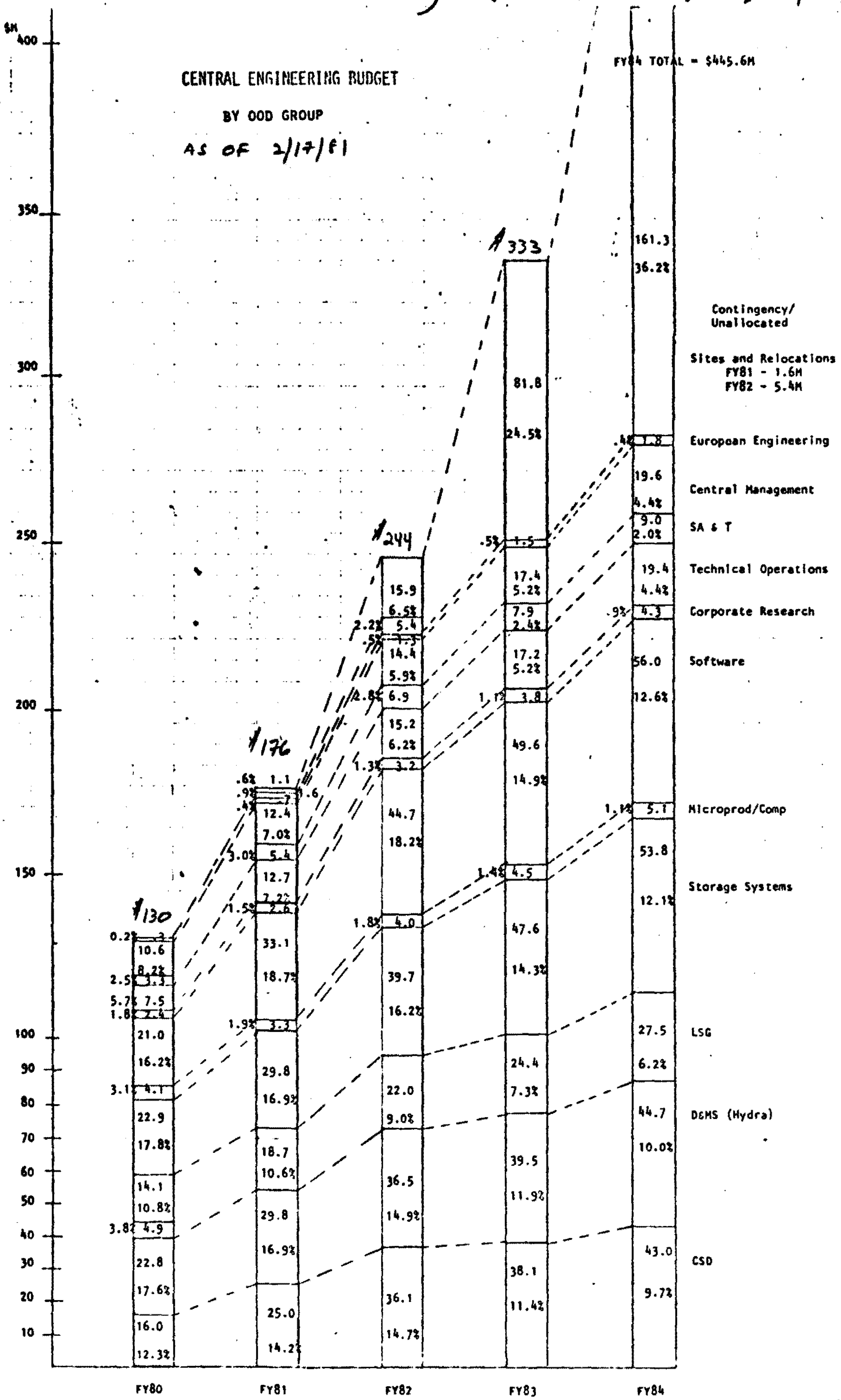


JS 11/7/80

V.E.8

Company

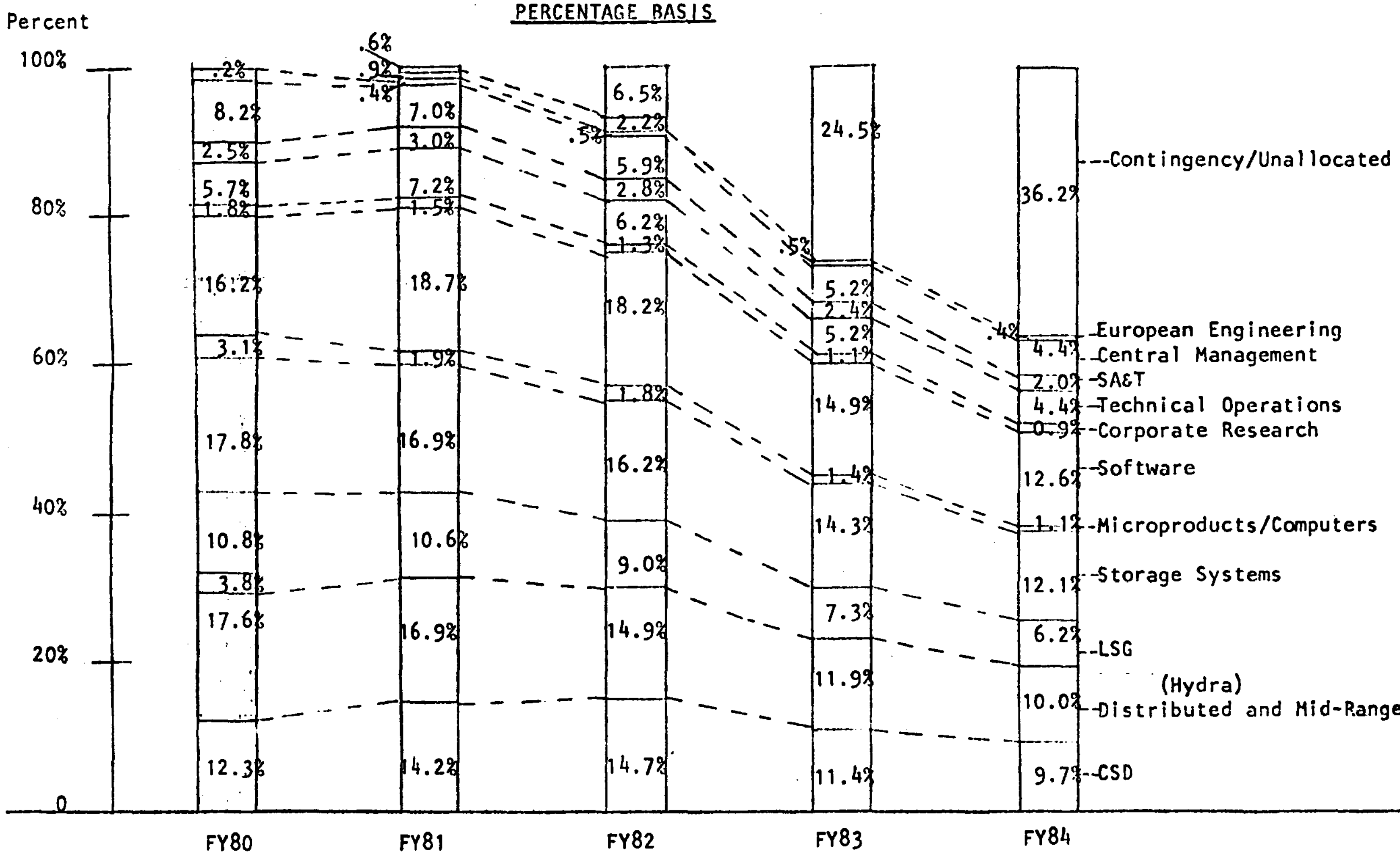
C) Budget Overview - By OOD group - #



* * "COMPANY CONFIDENTIAL" * *

PER HJERPPE 2/17/81

CENTRAL ENGINEERING BUDGET BY OOD GROUP
AS OF 2/17/81
PERCENTAGE BASIS



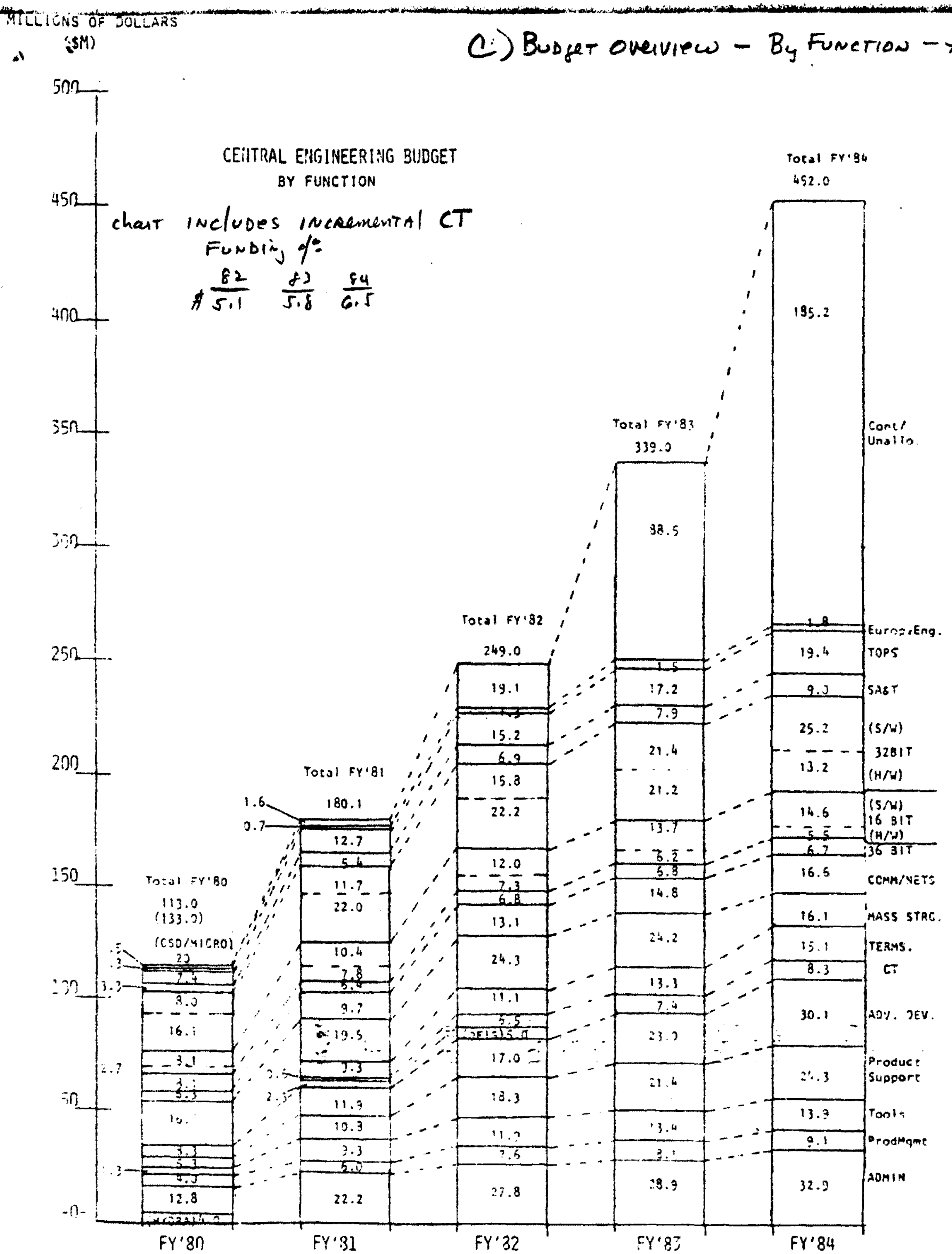
IV-18

(4) Budget Overview - By OOD group - %

C O M P A N Y   C O N F I D E N T I A L
DIGITAL EQUIPMENT CORPORATION

Per Hjerppe
2/17/81

C) Budget overview – By Function – $



IV-19

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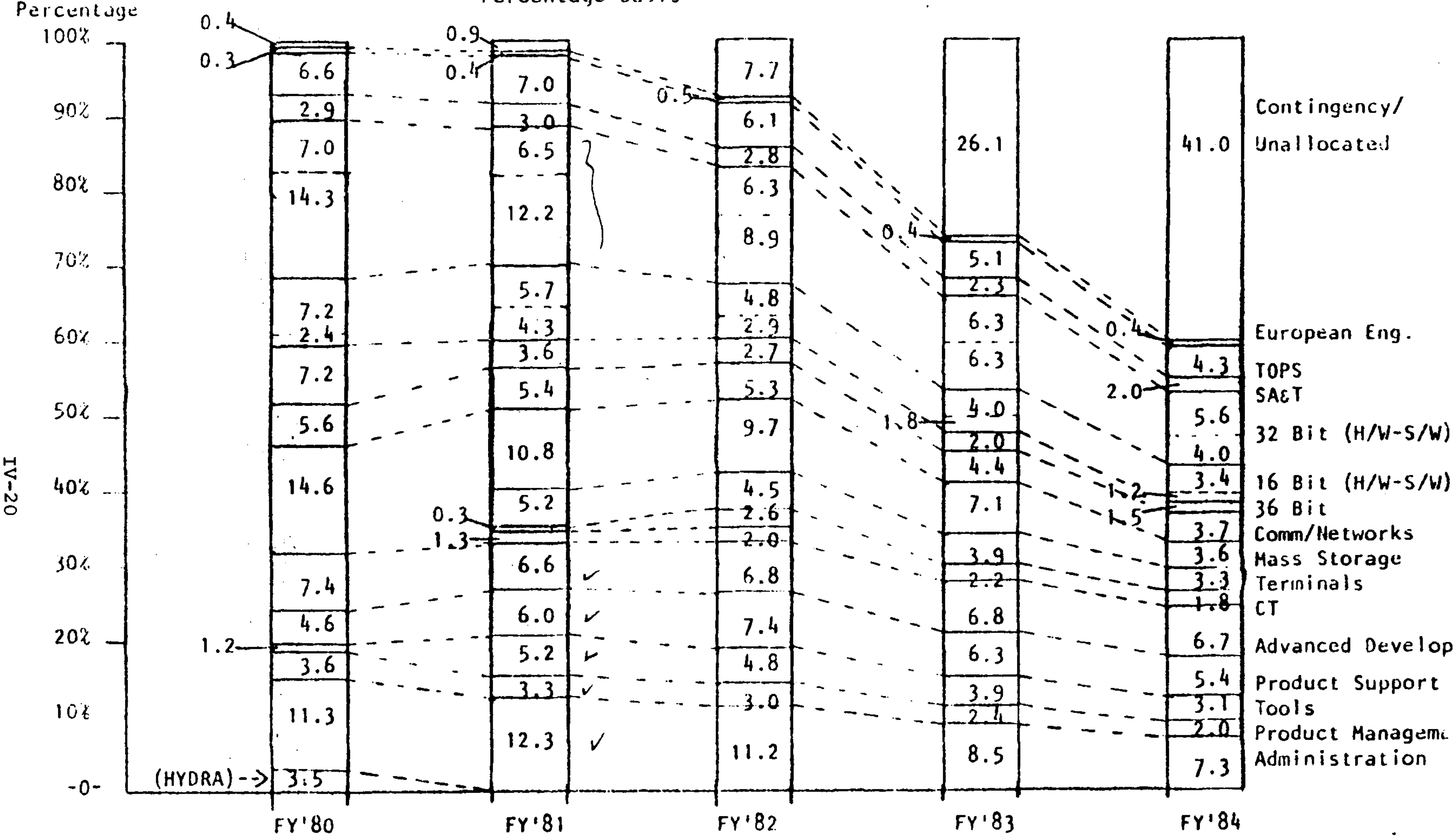
P. Hjerppe 3/11/81

NB: chart includes incremental CT Funding for 82-84, NOT part of Approved Budget.

CENTRAL ENGINEERING BUDGET BY FUNCTION

Percentage Basis



C) Budget Overview - By Function - %

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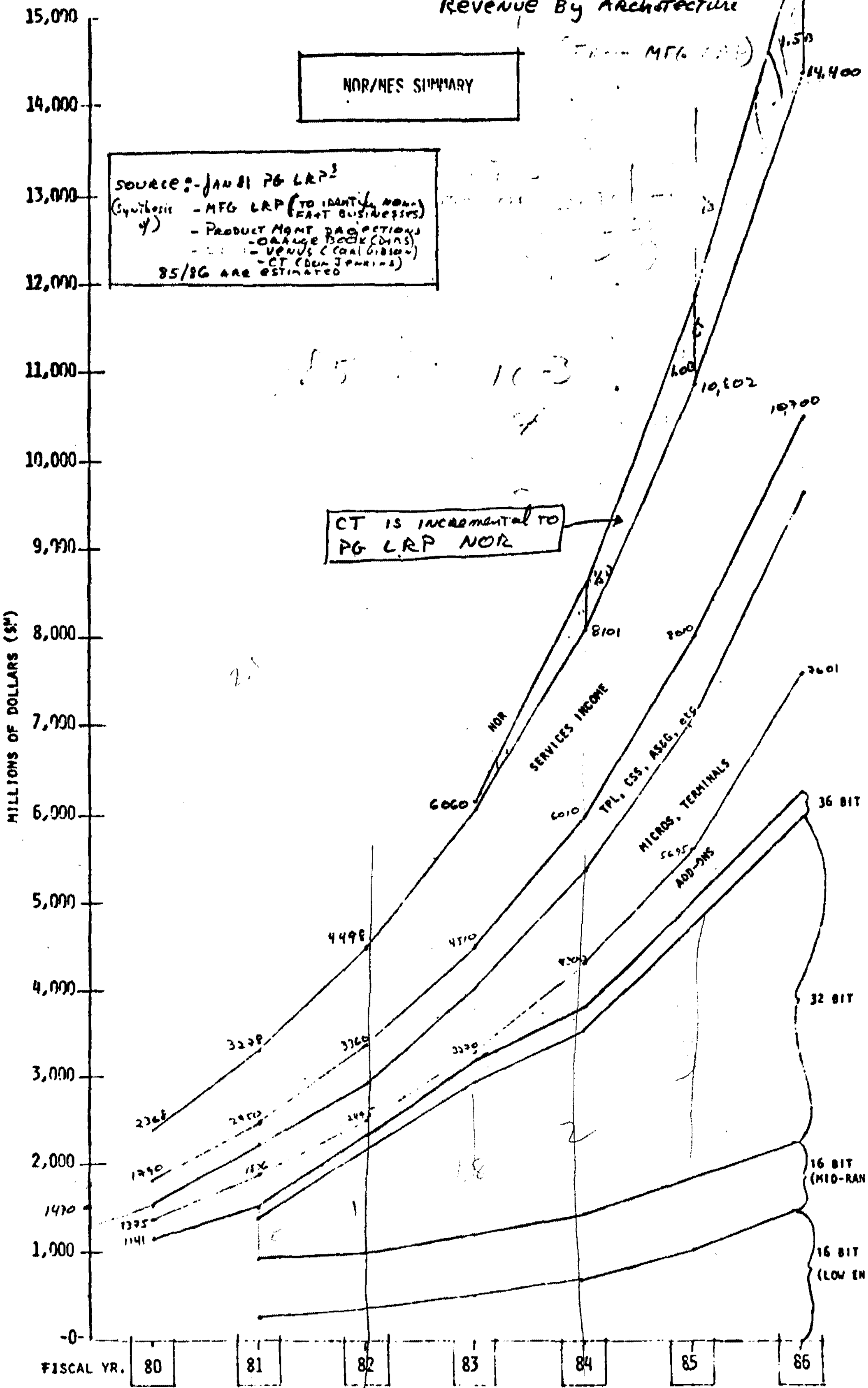
P. Hjerppe 3/11/81

D) Tests of Budget Allocation
Revenue By Architecture



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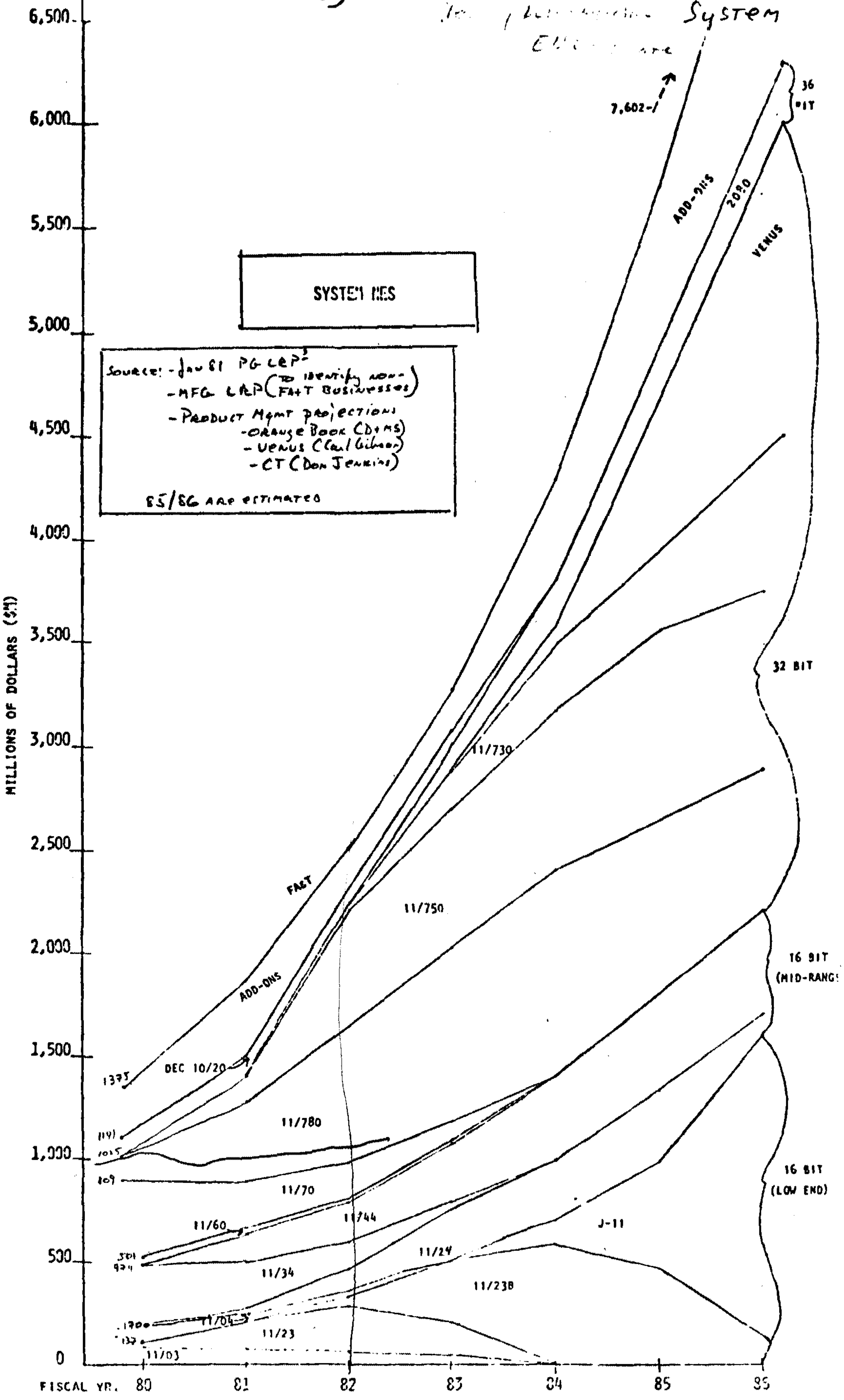
PH 2/25/81

D) Tests of Budget Allocation Revenue & ... System



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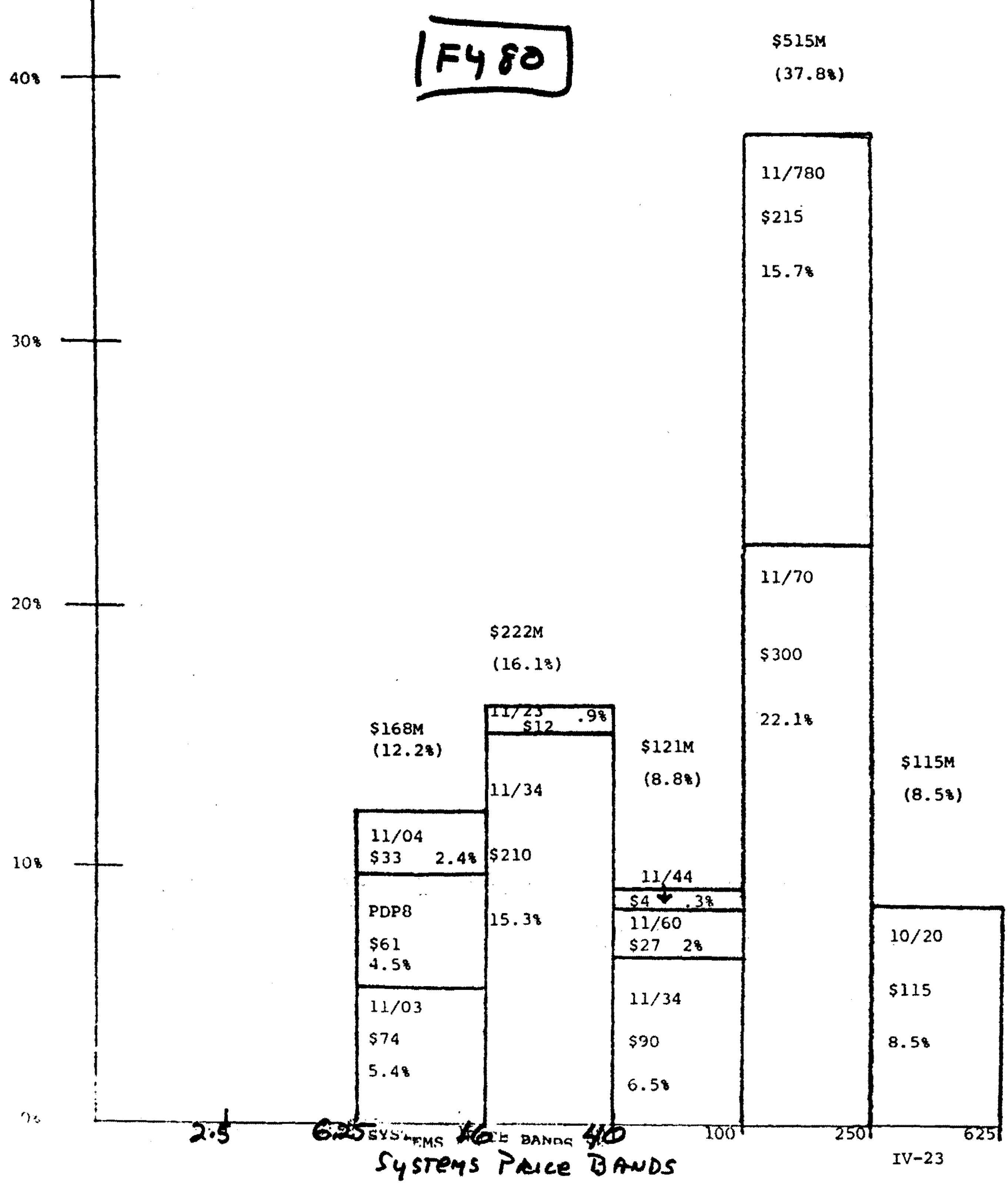
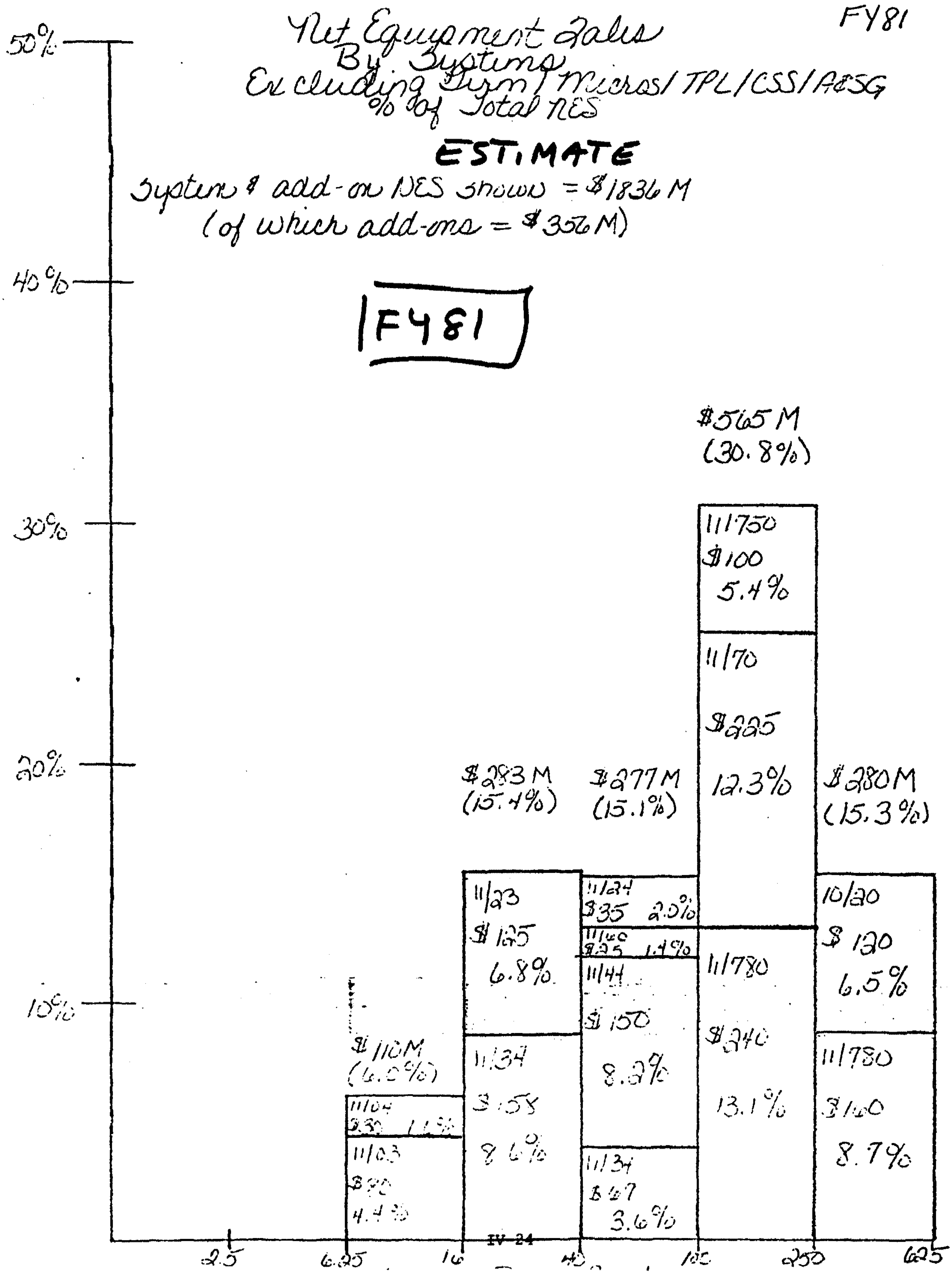
D) Tests of Budget Allocation — NES By System

FY80

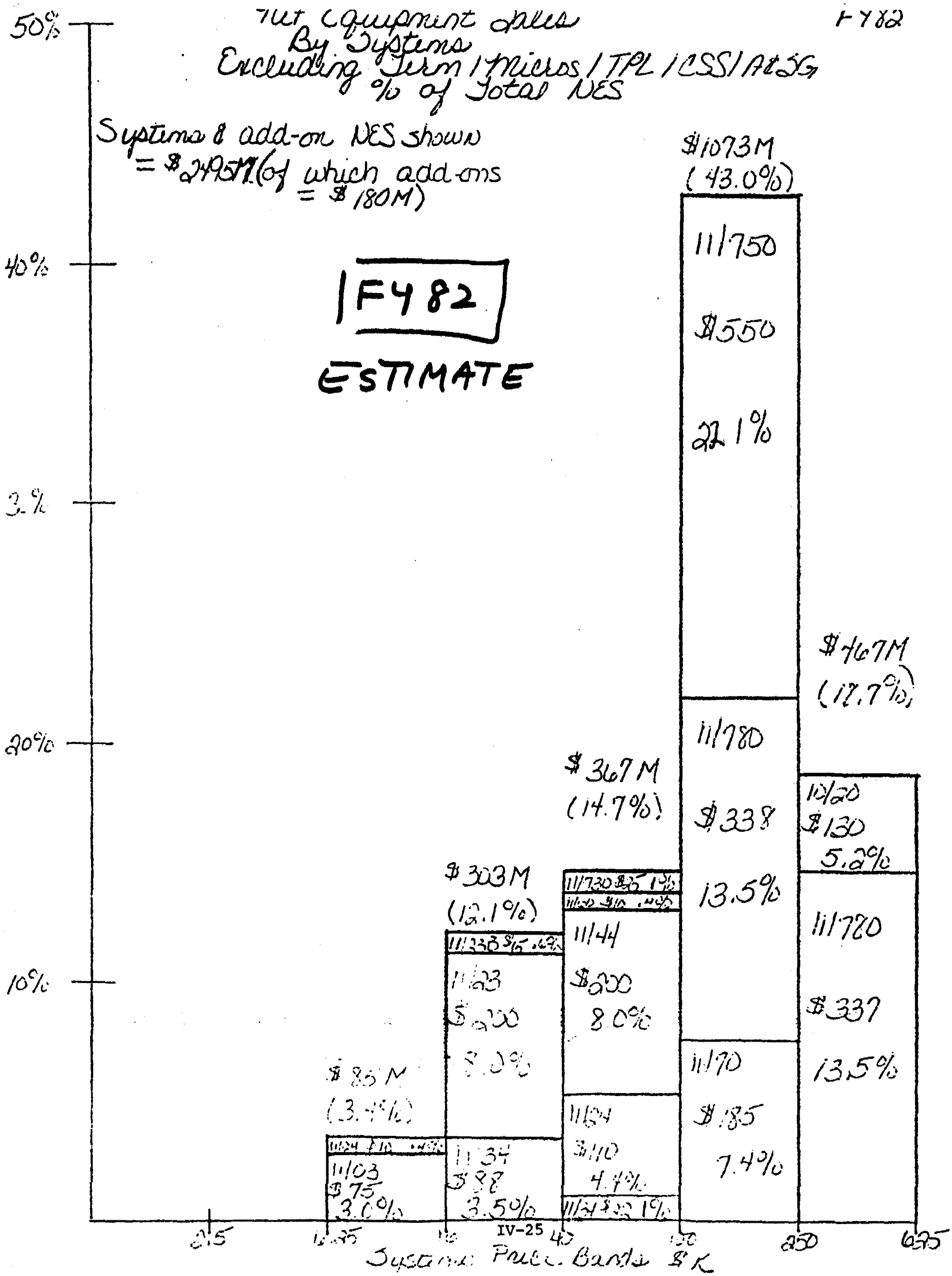
NET EQUIPMENT SALES
BY SYSTEMS
EXCLUDING TERM/MICROS/TPL/CSS/A&SG
% OF TOTAL NES

Systems and Add-ons NES shown = $1375M (of which add-ons = $234M)



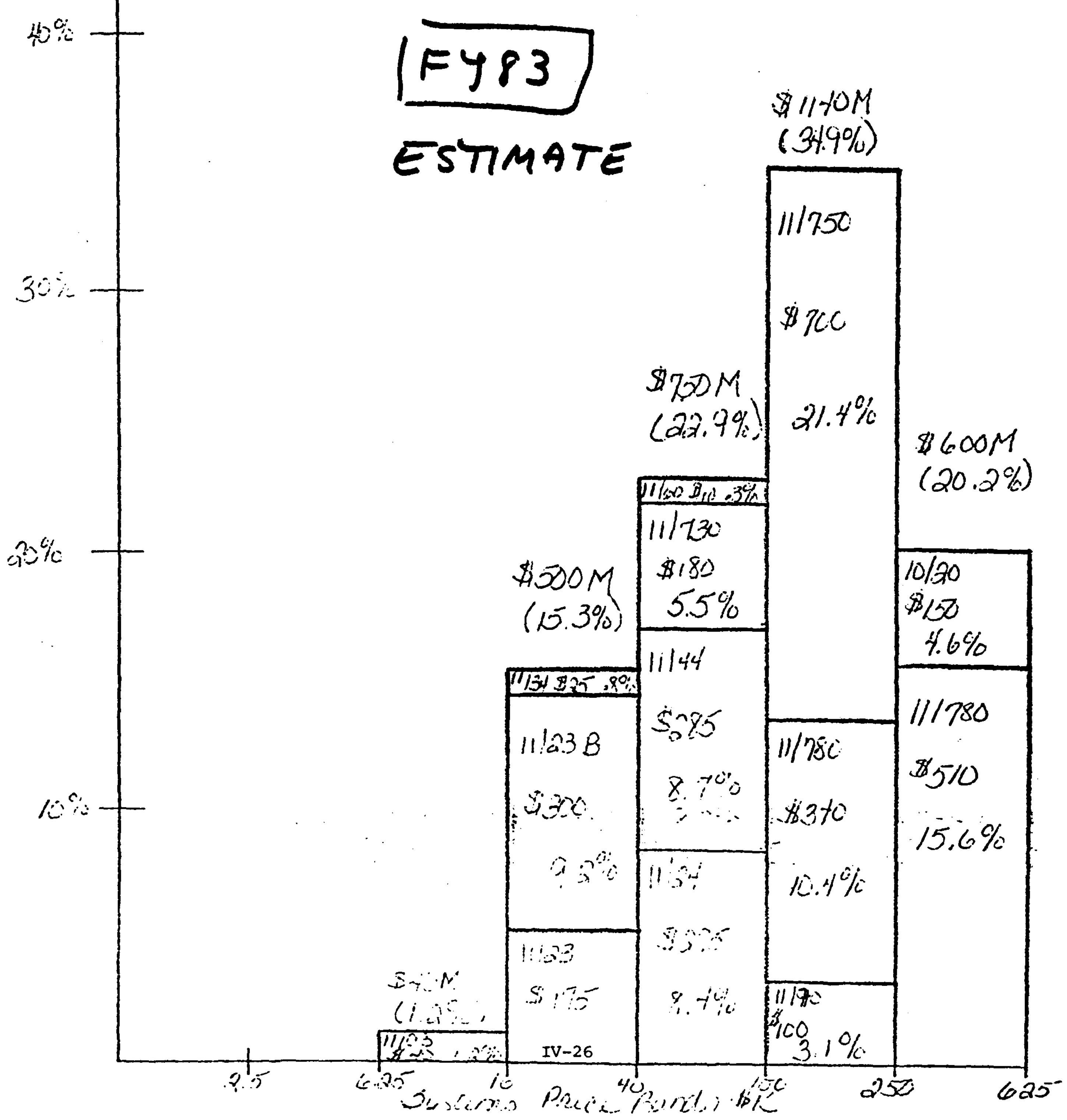


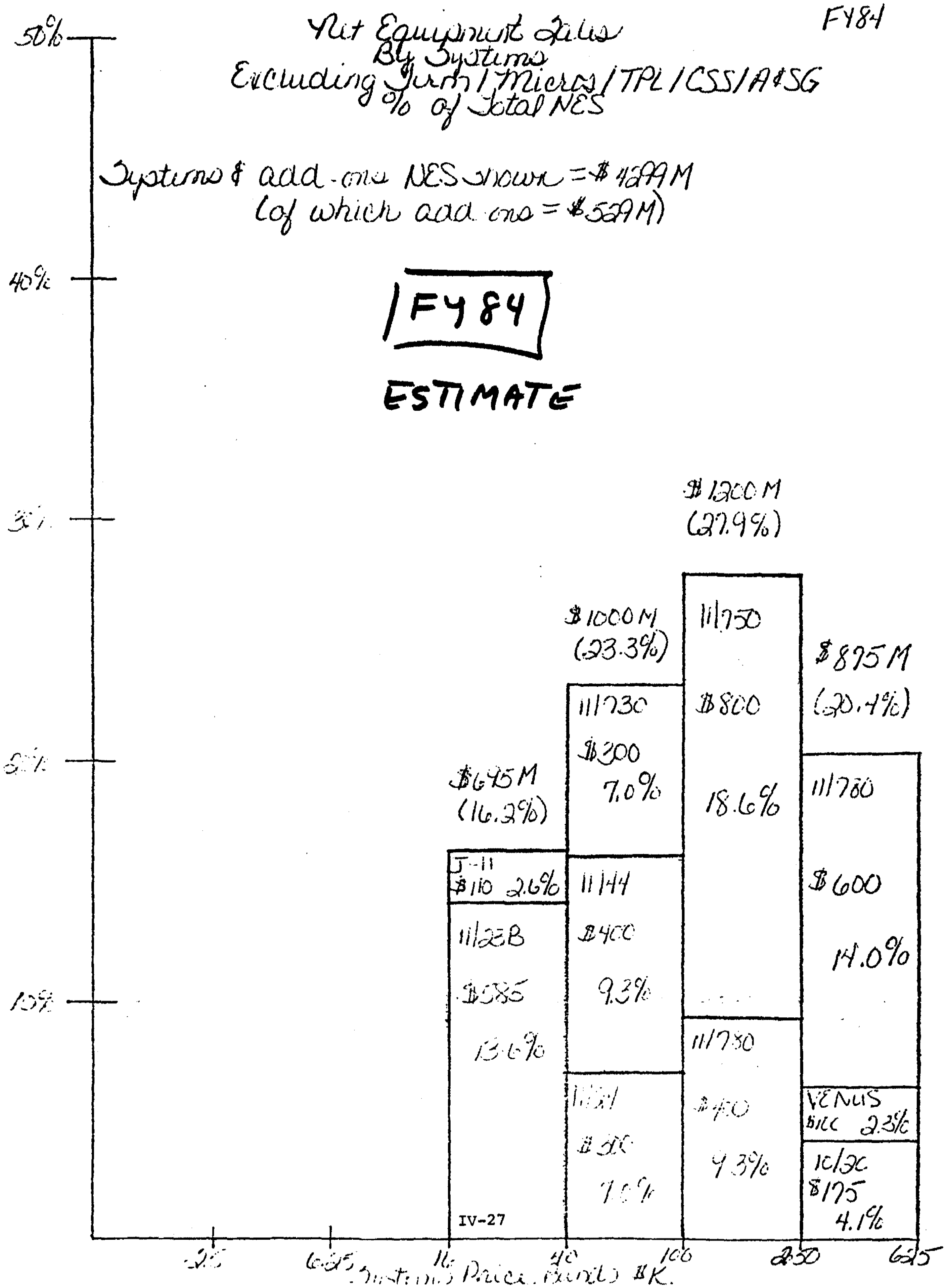
FY81
Net Equipment Sales
By Systems
Excluding Term/Micros/TPL/CSS/A&SG
% of Total NES
ESTIMATE
System & add-on NES shown = $1836 M
(of which add-ons = $356 M)
FY81
50%
40%
30%
20%
10%
$110M
(6.0%)
11/04
$30 1.6%
11/03
$80
4.4%
$283 M
(15.4%)
11/23
$125
6.8%
11/34
$158
8.6%
$277 M
(15.1%)
11/24
$35 2.0%
11/60
$25 1.4%
11/44
$150
8.2%
11/34
$67
3.6%
$565 M
(30.8%)
11/750
$100
5.4%
11/70
$225
12.3%
11/780
$240
13.1%
$280 M
(15.3%)
10/20
$120
6.5%
11/780
$160
8.7%
2.5
6.25
10
40
100
250
625

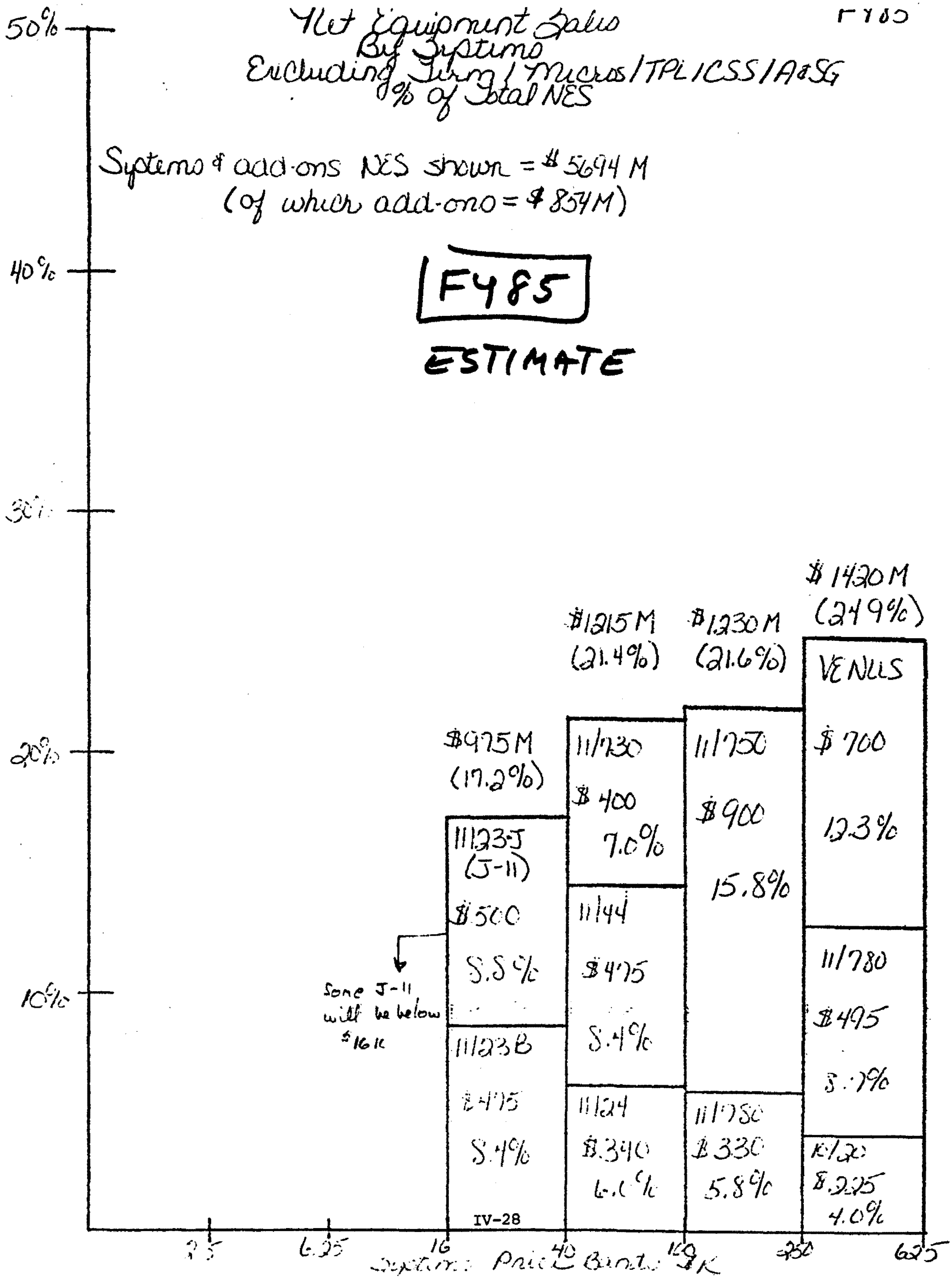

Net Equipment Sales
By Systems
Excluding Term/Micros/TPL/CSS/A&SG
% of Total NES
F Y 82
Systems & add-on NES shown
= $2495M (of which add-ons = $180M)
F Y 82
ESTIMATE
50%
40%
3 %
20%
10%
$1073M
(43.0%)
11/750
$550
22.1%
11/780
$338
13.5%
11/70
$185
7.4%
$467M
(18.7%)
10/20
$130
5.2%
11/780
$337
13.5%
$367 M
(14.7%)
11/730 $25 1%
11/60 $10 .4%
11/44
$200
8.0%
11/24
$110
4.4%
11/21 $22 1%
$303M
(12.1%)
11/38 $15 .6%
11/23
$200
8.0%
11/34
$88
3.5%
$85 M
(3.4%)
11/24 $10 .4%
11/03
$75
3.0%
2.5
12.5
15
40
100
250
625
Systems Price Bands $K

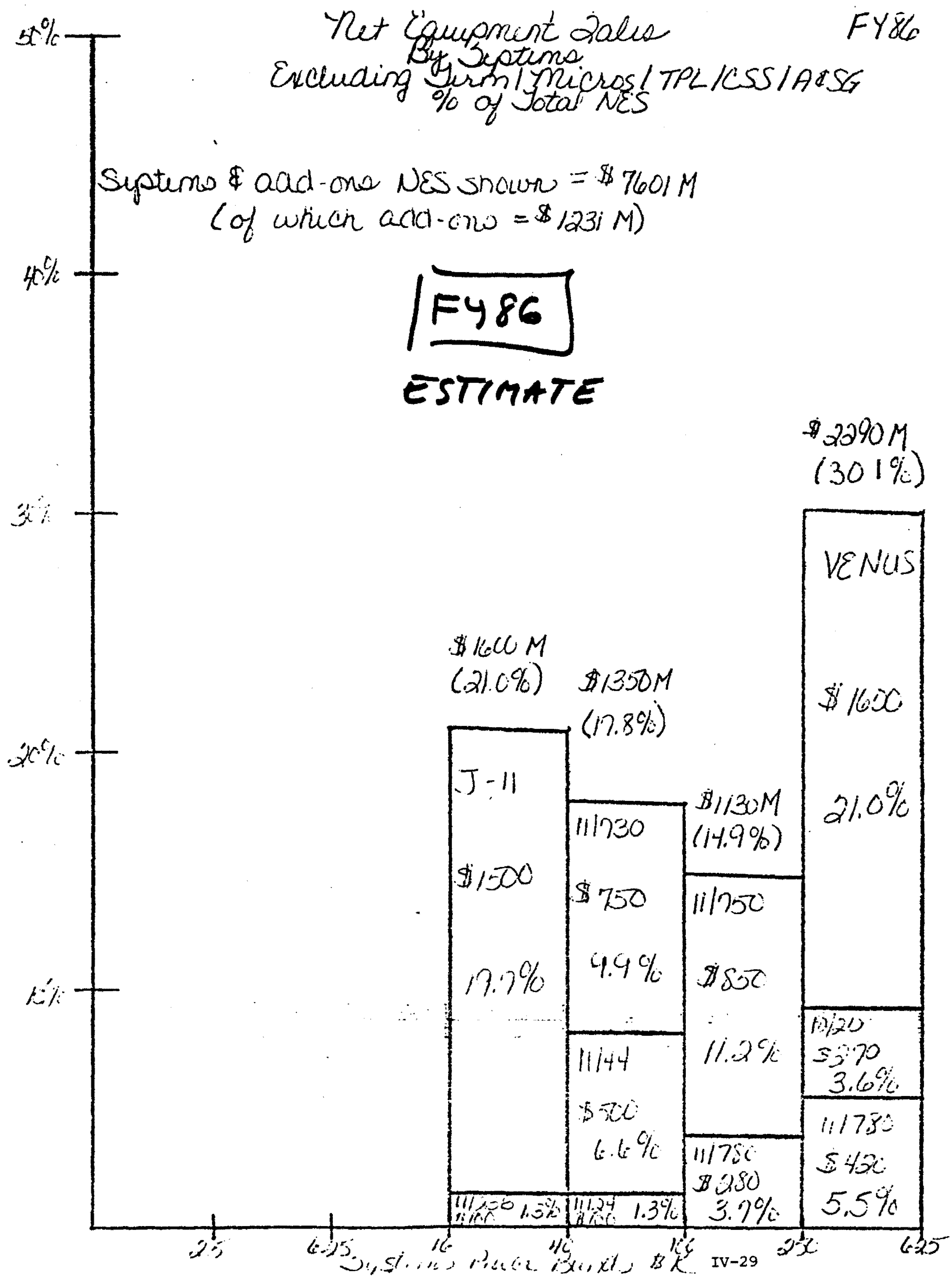
Net Equipment Sales
By Systems
Excluding Terms/Micros/TPL/CSS/A&SG
% of Total NES

Systems & add-ons NES shown = $3270M
(of which add-ons = $180M)



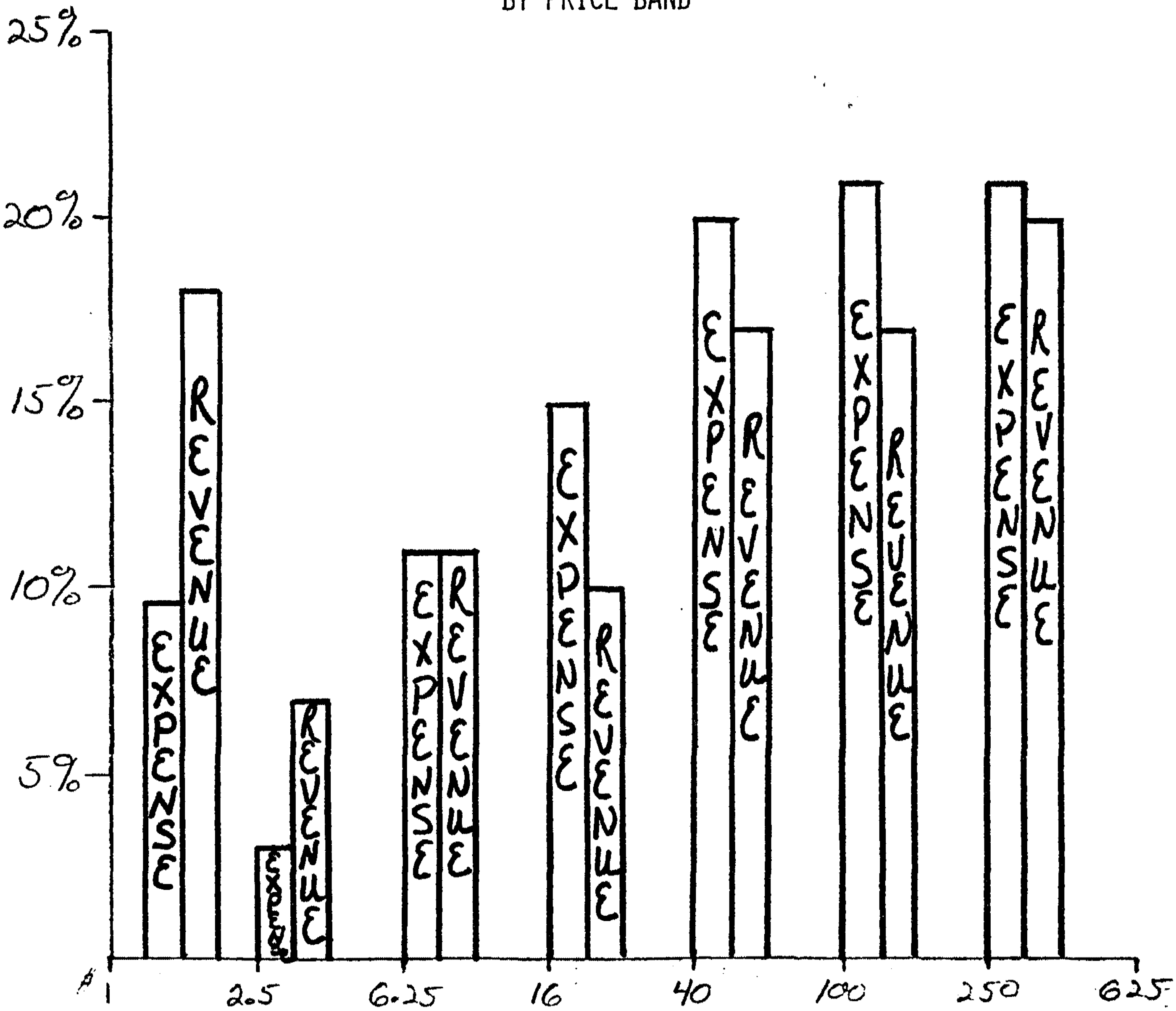

Net Equipment Sales
By Systems
Excluding Term/Micros/TPL/CSS/A&SG
% of Total NES
Systems & add-ons NES shown = $4299 M
(of which add ons = $529 M)
FY84
ESTIMATE
50%
40%
30%
20%
10%
$695 M
(16.2%)
J-11
$110 2.6%
11/23B
$585
13.6%
$1000 M
(23.3%)
11/730
$300
7.0%
11/44
$400
9.3%
11/24
$300
7.0%
$1200 M
(27.9%)
11/750
$800
18.6%
11/730
$400
9.3%
$875 M
(20.4%)
11/780
$600
14.0%
VENUS
$100 2.3%
10/20
$175
4.1%
2.5
6.25
15
40
100
250
625
Systems Price Bands $K.


Net Equipment Sales
By Systems
Excluding Term/Micros/TPL/CSS/A&SG
% of Total NES
Systems & add-ons NES shown = $5694 M
(of which add-ons = $854M)
F485
ESTIMATE
50%
40%
30%
20%
10%
$975M
(17.2%)
11/23-J
(J-11)
$500
8.8%
Some J-11 will be below $16K
11/23B
$475
8.4%
$1215M
(21.4%)
11/730
$400
7.0%
11/44
$475
8.4%
11/24
$340
6.0%
$1230M
(21.6%)
11/750
$900
15.8%
11/730
$330
5.8%
$1420M
(24.9%)
VENUS
$700
12.3%
11/780
$495
8.7%
K/20
$225
4.0%
2.5
6.25
16
40
100
250
625
Systems Price Bands $K


Net Equipment Sales
By Systems
Excluding Term/Micros/TPL/CSS/A&SG
% of Total NES
FY86
Systems & add-ons NES shown = $7601 M
(of which add-ons = $1231 M)
FY86
ESTIMATE
50%
40%
30%
20%
10%
$1600 M
(21.0%)
J-11
$1500
19.7%
1.5%
$1350M
(17.8%)
11/730
$750
9.9%
11/44
$500
6.6%
1.3%
$1130M
(14.9%)
11/750
$850
11.2%
11/780
$280
3.7%
$2290 M
(30.1%)
VENUS
$1600
21.0%
10/20
$270
3.6%
11/780
$420
5.5%
2.5
6.25
16
40
100
250
625
Systems Price Bands $K

D) TESTS OF BUDGET ALLOCATION

ESTIMATE
82 ENGINEERING SPENDING
VS
85 NES (EXCLUDES NES FROM ADD-ONS, A&SG, TPL, CSS)
BY PRICE BAND



OBSERVATIONS:

1) REVENUE IS BASED ON PG LRP OF JAN 81. (REVENUE FOR TERM, MICROS IS PROBABLY OVERSTATED, THEREFORE, OVERSTATING THE UNDER $2.5K PRICE BAND.) LOWER 85 REVENUE PROJECTIONS FOR TERM/MICROS MIGHT REDUCE THE PORTION OF UNDER $2.5K PRICE BAND TO 13% OF TOTAL.
2) ENGINEERING SPENDING IS <u>REASONABLY</u> WELL BALANCED AGAINST PROJECTED REVENUE BY PRICE BAND. MAY BE TOO LIGHT AT LOW-END.

D) TESTS OF BUDGET ALLOCATION

COMMENTARY
MARKET SIZE

Total World 1979 Market, all price bands, was appx. $38B according to IDC. The market from $1K to $625K was about $16B, giving Digital about a 13% Market Share.

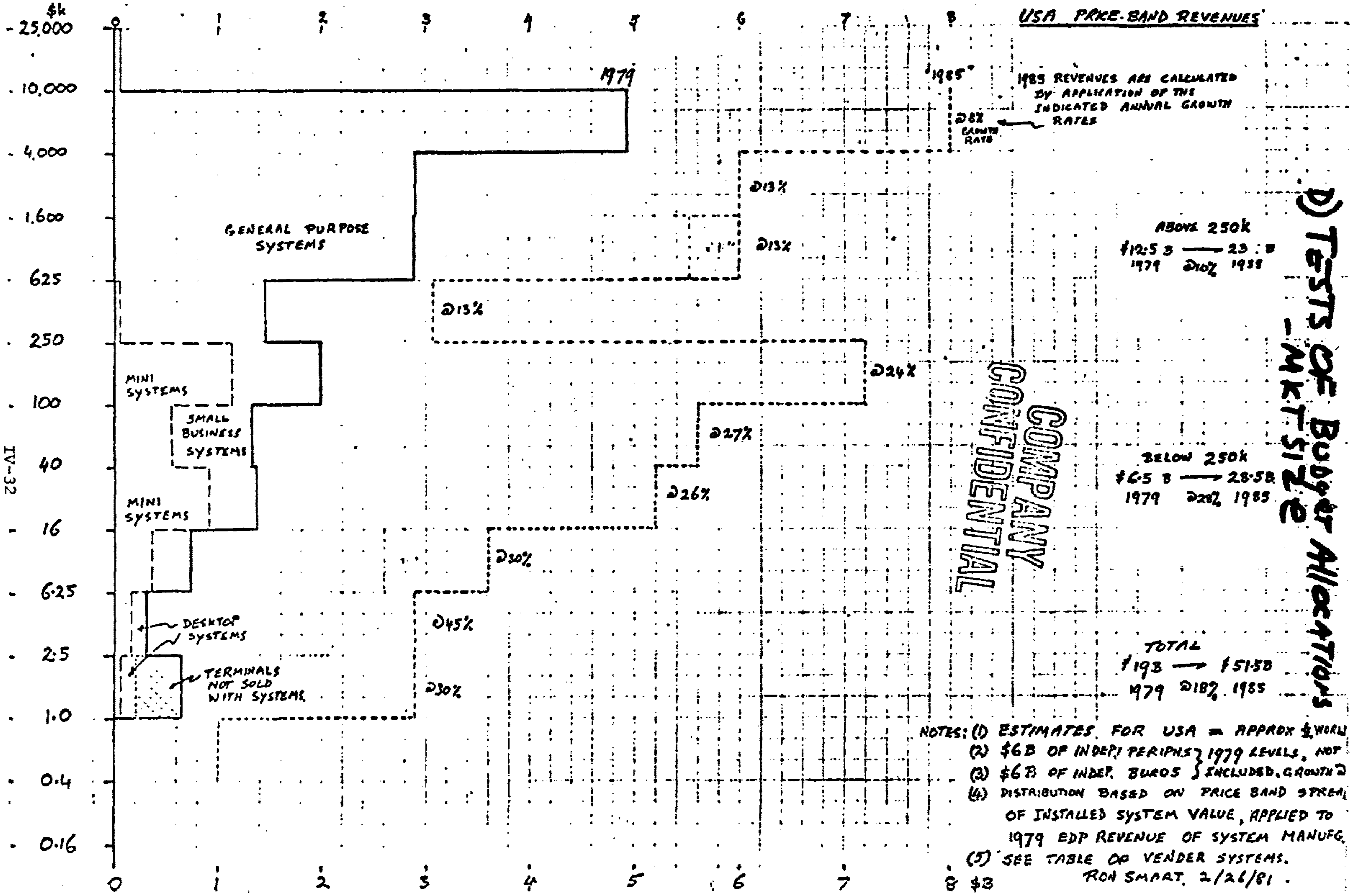
By 1985, the $1K - $625K Market is projected to grow to $63B or about 26% annually. PG LRP NES (from FY80 to FY86) grows 35% annually giving an implied market share of 20%.

Market size is projected (by Corporate Marketing) to grow most rapidly in the lower ranges of the price bands. However, projections of DEC Systems shipments indicate substantial volumes in the $250K+ bands. There appears to be an imbalance especially in this high-end band by 85/86.

THIS MARKET DATA, AND PROJECTED DIGITAL REVENUE BY PRICE BAND, IS PRELIMINARY.

D) TESTS OF Budget Allocations - MKT SIZE

USA PRICE BAND REVENUES



NOTES: (1) ESTIMATES FOR USA = APPROX ½ WORLD
(2) $6B OF INDEP. PERIPHS } 1979 LEVELS, NOT
(3) $6B OF INDEP. BUROS } INCLUDED. GROWTH ?
(4) DISTRIBUTION BASED ON PRICE BAND SPREAD OF INSTALLED SYSTEM VALUE, APPLIED TO 1979 EDP REVENUE OF SYSTEM MANUFG.
(5) SEE TABLE OF VENDER SYSTEMS.

RON SMART 2/26/81

D) Tests of Budget Alloc. – MKT Size

USA MARKET $M, USING IDC CATAGORIES

(WORLD IS "APPROX" DOUBLE THIS)

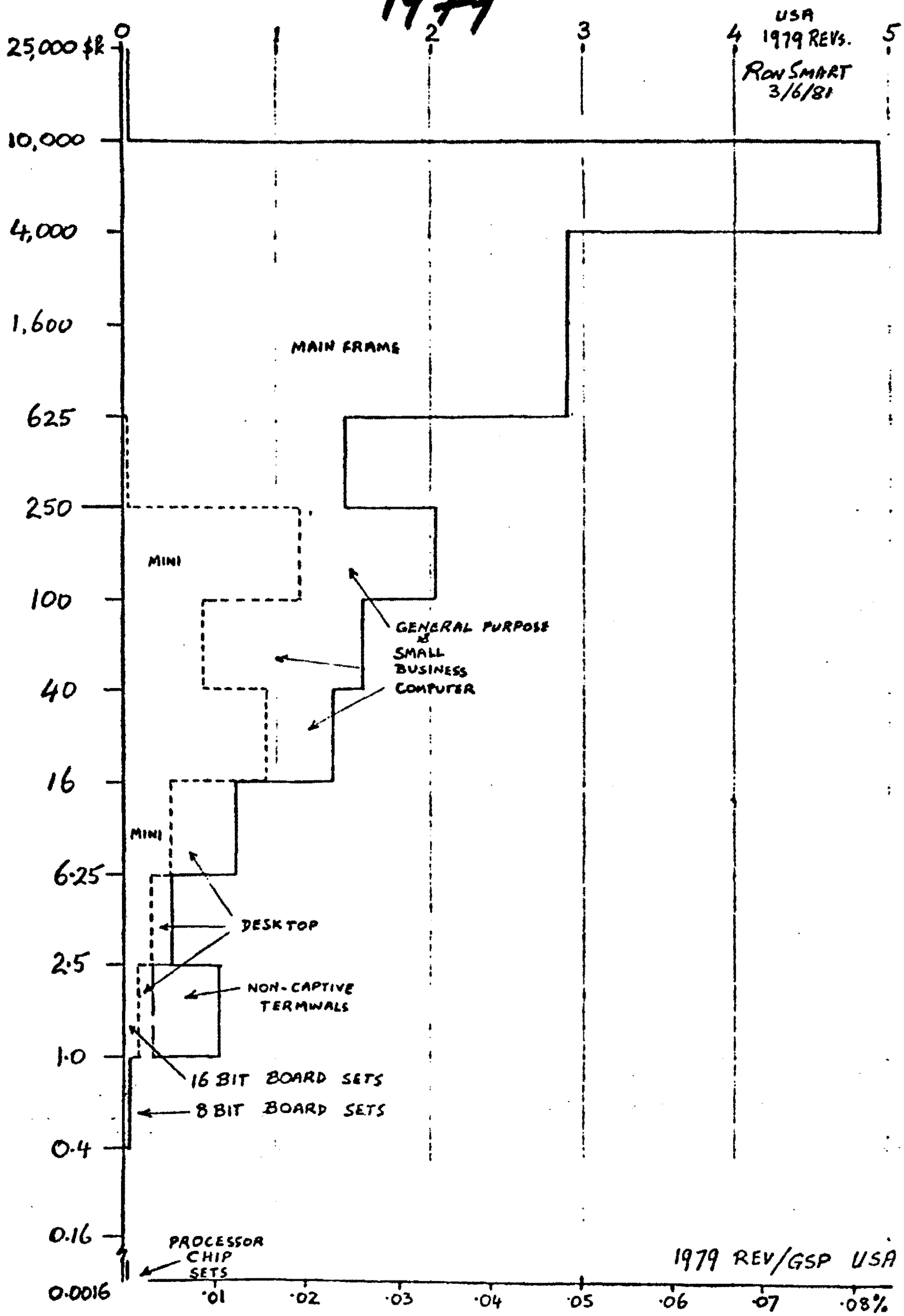
Ron Smart
2/24/81

												NOR
"1985" REVS:	3,000	2800	3600	5500	6500	7300	3000	6000	6000	8000		51,700
EXAMPLE ANNUAL GROWTH SCENARIO	30%	45%	31%	26%	27%	24%	13%	13%	13%	8%		18%
1979 REVS.	620	302	722	1378	1553	2020	1450	2895	2890	4950	45	18,825
TERMS (OTHR)	400											400
OTHER DESK	120	160	142	43								465
OTHER SBC			10	220	150							380
OTHER MINIS		60	125	235	215	230	50					915
DG		10	20	120	190	120					9147 H/W P/C? 1158	460
HP			200	140	-	200					+25	540
DEC (per IDC)		120	130	320	100	510	40	80		DEC US	1/279 calc NOR →	1300
DEC (Per RCN)	100	70	150	300	150	450	30	50				1300
CRAY AMDL									200	35		235
NCR				20	145	190	470	275				1,100
CDC						30	30	140	250	470	20	940
HIS				30	30	210	90	200	300	110		970
BUR				50	50	250	150	500	300	130		1,430
UNIV.		2	5	20	53	30	150	220	470	300		1,250
IBM			70	200	570	310	480	1510	1370	3905	25	8440
TOTAL	620	302	722	1378	1553	2020	1450	2895	2890	4950	45	18825
GP					95	850	1410	2925	2890	4950	45	13,165
MINI		192	320	923	508	1170	50					3,163
SBC			20	360	900	60						1340
DESK	120	160	362	115								757
TERMS	400											400
TOTAL	520	352	702	1398	1503	2080	1460	2925	2890	4950	45	18,825

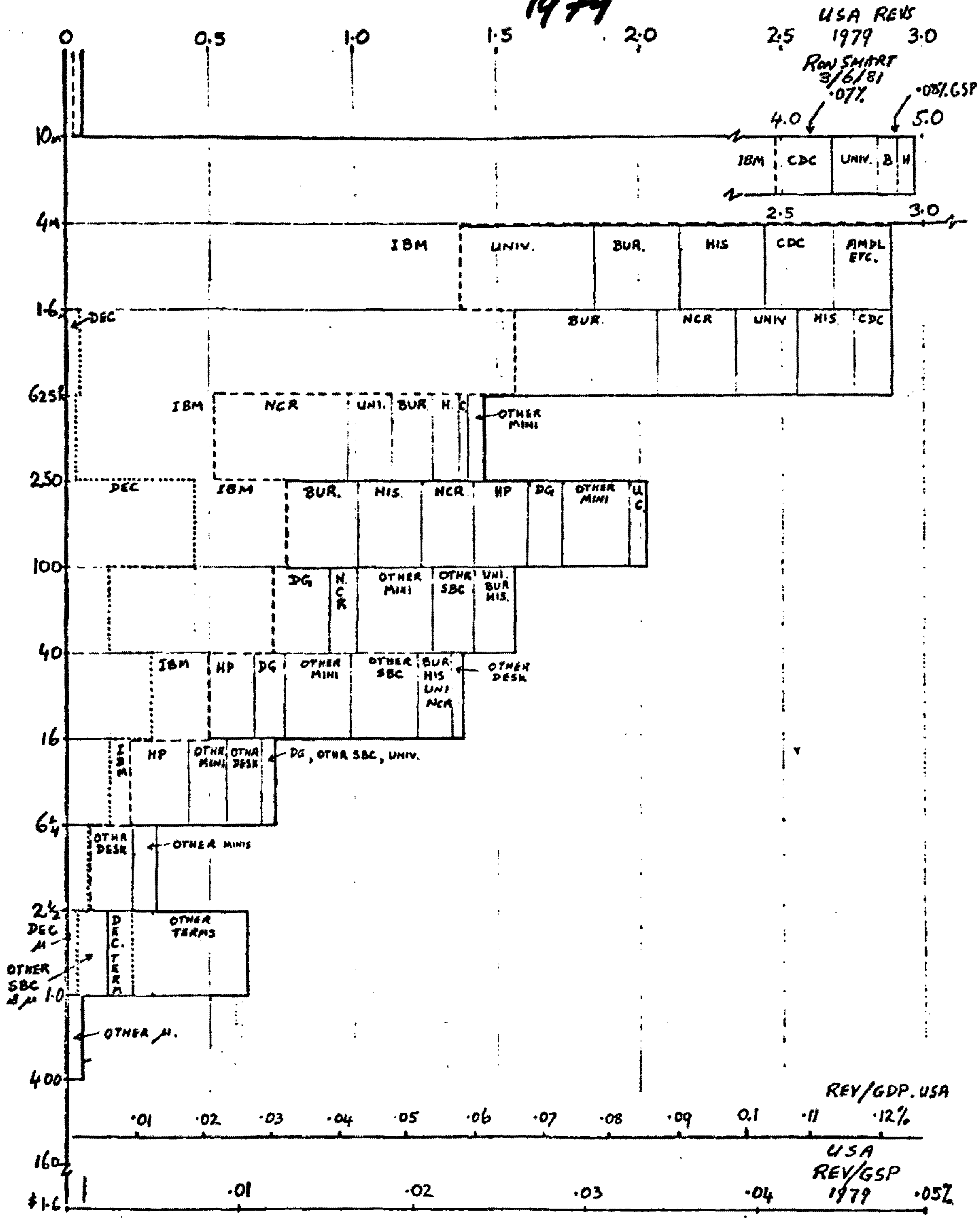
COMPANY CONFIDENTIAL

D) TESTS OF BUDGET ALLOCATION - MKT SIZE - USA.

1979



D) Tests of Budget Allocation - MKT Size - USA 1979



PRODUCT MAPPING

Rev. SMART 2/24/81

NIXDORF												
SIEMENS												
CIEHB												
ICL												
HITACHI												
NEC												
FUJITSU												
DIG. MICRO			DCS									
PERTEC				PCC, MITS								
VECTOR			SYS-B									
COMMODORE	PET											
CROMEMCO				SYS-3								
TEKTRONIX				4051								
ADDS				VANTAGE								
RADIO SHACK		TRS-80/I	TRS-80/II									
APPLE			APPLE-II									
WANG			PCS-1,2		2200	2200VS						
QANTEL				210	950,960	13xx 14xx						
BASIC4					200 410	610	700,730					
MICRODATA			M-1	32xx	R2000	R-4,6,8000						
T.I.				990/5	990/10	990/12						
SEL						32/30	32/75					
MODCOMP						C-7830	C-7860,70					
CA		3/05 4/10	4/30	4/90								
GA			16/1xx	16/3xx	16/4xx	16/5xx						
TANDEM												
PERKIN-E			5/16, 6/16		8-16		3240					
HARRIS						6024/6	S-1xx	S-5,800				
PRIME				100	200	450	550-750					
DG		MP100, 200	N-4/C	N-2	CS/20,30 N-4/5, X	CS/40-60 ECLIPSE	ECLIPSE					
HP				9825, 35	9845 1000-M,E,F	250, 300	3000					
DEC		VT LA LSI-11	PDT KFD	11/03-23	11/34-40	11/750 11/44-60	11/780 11/70	2020	1091 2060			
OTHERS												
AMDAHL										AM470		
NCR					81xx	82xx	8350	8370	8565	8670		
CDC					C/18-5	C/18-20	C/18-30	Ω-480	C170-720	C170-730	C170-760	
HIS					6/23	6/33	H62-40	H 64/300	H-66/440	H-66/DPS	H.6S	
BURR					B90	B800	B1830	3900	4800	6900	7800	
UNIVAC			V77-200		V77-400	BC/7	90/25	90/30	90/40-70	1100/10-60	1100/80	
IBM				5120	SERIES-1 5520	8130 S/32, 34 S/3-4,6,8	360/20 8140 S/38-3 S/3-10,12	370/115 4331 S/38-5	370/145 4341	370/145 3031	370/158 3032 3033	370/195

RON SMART 2/26/81 (FROM IDC DATA)

Price band	IBM USA: First instl	Models	12/79 Base $M	1979 Revs	Other mainframes: Univac Base	Univac Revs	Burr Base	Burr Revs	HIS Base	HIS Revs	CDC Base	CDC Revs	NCR Base	NCR Revs	DEC & Others Base	DEC & Others Revs	H.P Base	H.P Revs	DG Base	DG Rev	Other Mini Base	Other Mini Rev	Other SBC Base	Other SBC Rev	Other Desktop Base	Other Desktop Rev
5,000k	71	370/195	125	25							48 "STAR 100"	20														
2,000k	66-69 73 78	360/67-9x 370/158-16x 3032, 33	285 13,713 5,658	3905	897 "1100/8x"	300	325 "7800"	130	494 "H-68/DPS"	110	780 "C-203" "C-176,175,174" "C-170-750/760"	470			74 "CRAY-1"	35										
1,000	65 71 78	360/65, (70/60) 370/145,155 3031	1 252 2 833 1 700	1370	1425 "90/80" "1100/10,20,60"	470	747 "6900"	300	1215 "H-66/DPS" "DPS 8/70" "DPS 8/52"	300	412 "C-170/730" "C-173,172"	250	"8670"		673 "AMDAHL-470"	200										
600	65-66 72-77 79	360/4x,5x;(70/...) 370/12x,13x,148 4341	1 540 5262 51	1510	577 "90/40,60,70"	220	1232 "4800"	500	893 "H 66/440/520" "DPS 8/44"	200	223 "C-170/720" "C-171"	140	330 "8565/75/85"	275	451 "DEC 2050/60"	80										
625	63-65 74 74 79/20	360/25,30;(14xx) 370/115 SYS/3-15 4331 / SYS/38-5	681 378 1032 98 / 0	480	457 "90/30"	150	356 "3900,2900"	150	362 "H-64/300" "DPS-8/20"	90	62 "Ω-480/1,2"	30	573 "8370,8450,8555"	470	69 "DEC 2020/40"	40					90 [illegible]	50 10 40				
250	60-67 65-71 70-76 80	1620, 14xx, 1130 360/20,22 SYS/3-10,12 SYS/38-3	219 100 1242 0	310	95 "90/25"	30	582 "1955/85" "1815/25/35"	250	317 "H-61,62" 315 "H 6/43/47/53"	70 140	90 "C-18" (MINI)	30	229 "8350, 8410"	190	161 "DATAPOINT-500" (SBC) 970 "11/70, VAX 11/780" (M)	60 450	424 "3000"	200 (M)	282 "ECLIPSE" (MINI) 8 "EC 300" (SBC)	120 0	436 [illegible]	230 [illegible]				
100	70-76 75-77	SYS/3-6,8,4 SYS/32, 34 (SBC)	359 1,227	70 500	108 "UC 7 (SBC)" 117 "V-77-600,800" (M)	20 33	1 "1905" 279 "B 700,800 (SBC)"	 50	139 "H-X16", 700 (OLD MINI)	30			32 "8270" 300 "8200, 8230, 8250" (SBC)	25 120	416 "11/45/50/55" (MINI)	100			301 "ECLIPSE" (MINI) 148 "CS 40/60/80" (SBC)	130 60	436 [illegible]	215 [illegible]	471 181 [illegible] 69 Basic 4 61 Qantel 60 Wang VS [illegible] others	150 60 50		
40	76 78	SERIES-1 (MINI) 5110 (DESKTOP)	210 213	160 40	51 "V-77-400" (MINI)	20	101 "B 80,90 (SBC)"	50	59 "H 6/23/33/34/36" (MINI)	30			23 "8130, 8150" (SBC)	20	189 "DATAPOINT-300" (SBC) 1262 "11/05/34" (MINI)	70 250	240 "1000-E,F" (MINI) 175 "9845" (DESK)	108 32	359 "NOVA 4S, x(A)" "NOVA 3/11, 3.5" 9 "CS 20/40 (SBC)"	120 0	880 229 TI 236 GA 163 PE 42 [illegible] 171 others	235 50 60 50 13 60	681 353 Wang 2200 39 [illegible] 295 other	220 136	132 128 Tektronix 4 other	43 43
16	75 80	5100 (DESKTOP) 5120 (" ")	56 0	70	29 (OLD 520, 620 (MINI))	5									10 "DECstn. 78,88" 5 "PDP-8 ..." 500 "8/a" (MINI)	10 120	188 "1000-M" (MINI) 290 "9835" (DESK)	50 150	248 "NOVA 3/12" "NOVA 2" "NOVA 4C"	20	308 [illegible]	125 [illegible]	22 8 Intertec 2 [illegible] 8 Apple 2 [illegible] 2 other	10	251 36 Wang [illegible] 35 [illegible] 24 [illegible] 156 other	142 10
6.25					3 "V-77-200" (MINI)	2									275 "LSI-11, 11/03" (MINI) + TERMINALS	120			30 "MICRONOVA" "NOVA 3/4" "mP100, 200"	10	164 133 C.A 13 [illegible] 3 [illegible] 15 others	60 50 4 5			142 28 [illegible] 23 [illegible] 25 TRS 80 (II) 23 [illegible] 39 others	120 25
2.5																									338 85 Apple (II) 172 TRS 80 (I) 13 [illegible] 49 Commodore 19 others	120 20 77 15
1.0																										
0.4													(NCR PERIPH. INCL.)													

5540 = OTHER INDEP. PERIPH.

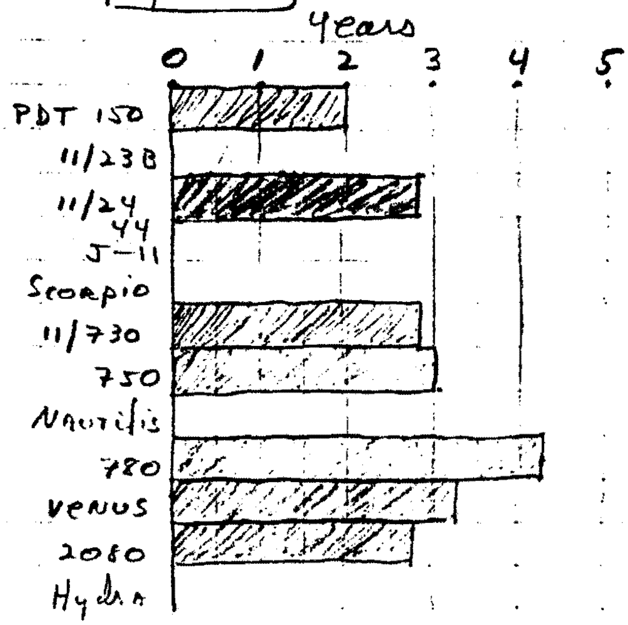
	IBM Base	IBM Revs	IBM USA Base	IBM USA Revs	Univac Base	Univac Revs	Burr Base	Burr Revs	HIS Base	HIS Revs	CDC Base	CDC Revs	NCR Base	NCR Revs	DEC & Others Base	DEC & Others Revs	H.P Base	H.P Revs	DG Base	DG Rev	Other Mini Base	Other Mini Rev	Other SBC Base	Other SBC Rev	Other Desktop Base	Other Desktop Rev
	2 780	1290	(1 114 PCM	955)	(.33)		(.4)		(.24)		SEAGATE BUFF (TO BE TAKEN OUT)	600	TERM, MAG, PRINTER → CRAY + AMDAHL →		920 747	200 235										
2.6 G.P.	47,763	12,930	36,528	7670	3510	1170	3243	1330	3281	770	1524 (.61)	910	1162 (.81)	960	520	120										
4.5 SBC	3,677	1360	1,227	500	48	20	380	100	0				323	140	360	140			165	60			1174	880		
8.0 MINI	2817	3163	210	160	200	60	0		513	200	90	30			3,423	1,040	852	358	1220	400	2309	915				
1.6 DESK	1602	757	269	110	0				0						5		465	182	1	0					863	465
2.6 ..	66,644	25,210 (USA RES) 47,550	38,234	8440 18340		1250 2270	3623	1430 2,430		970 1450		1540 2270		1100 2400		1300 2090		540 1030		460 1480		915 1162		380		465 465

E) Product Fin. Metrics

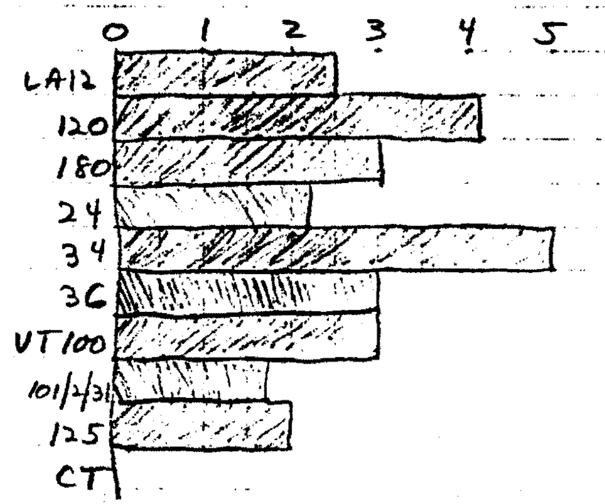
Financial Metrics

Years to Breakeven From FRS

Systems

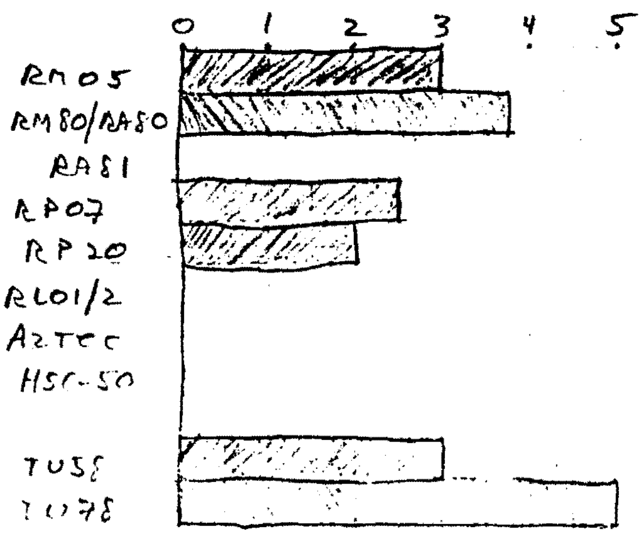


Terminals



how fast do terminals become obsolete?

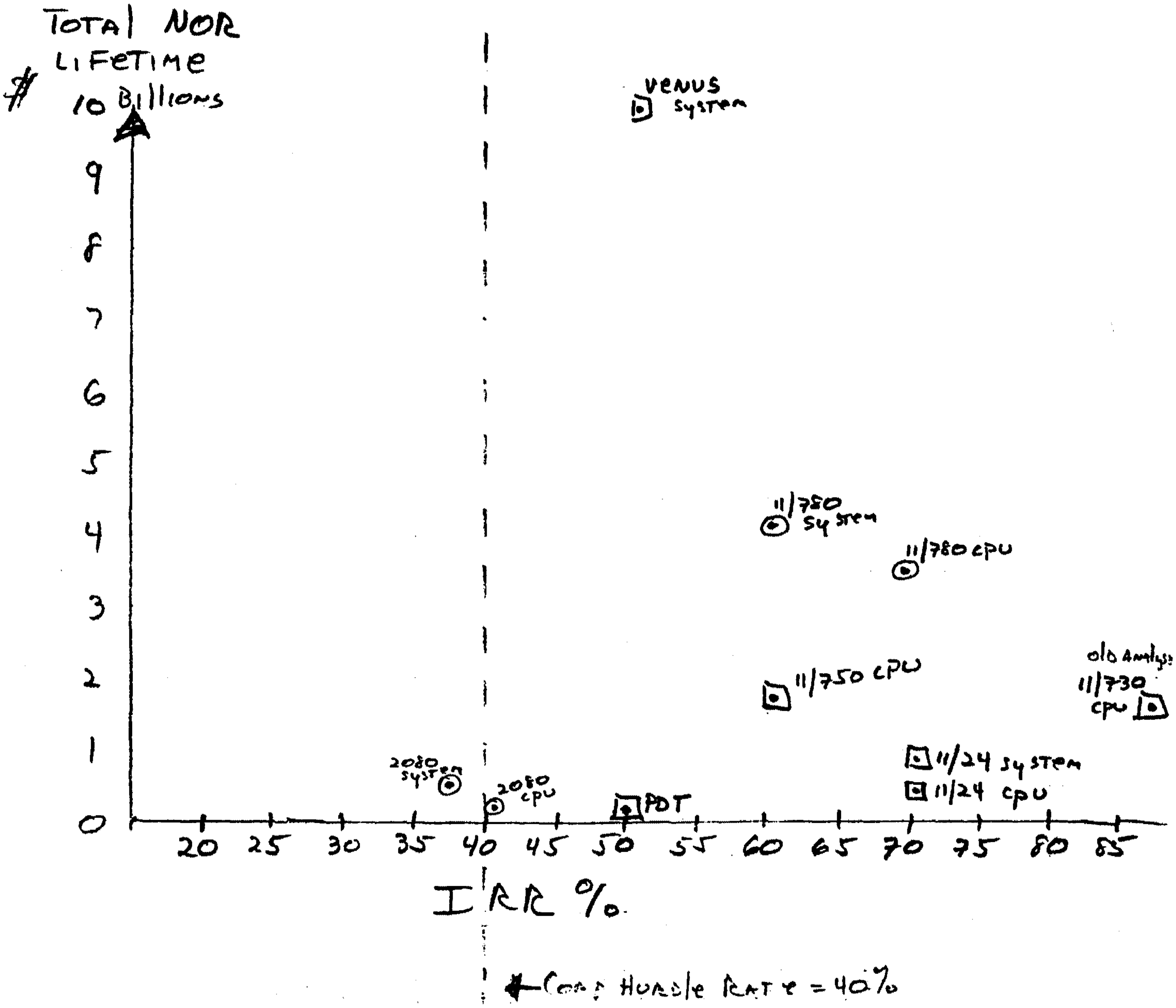
Storage



Source: Product Business Plans (BURP)

D.Clinton

Financial Metrics
NOR vs IRR
Systems

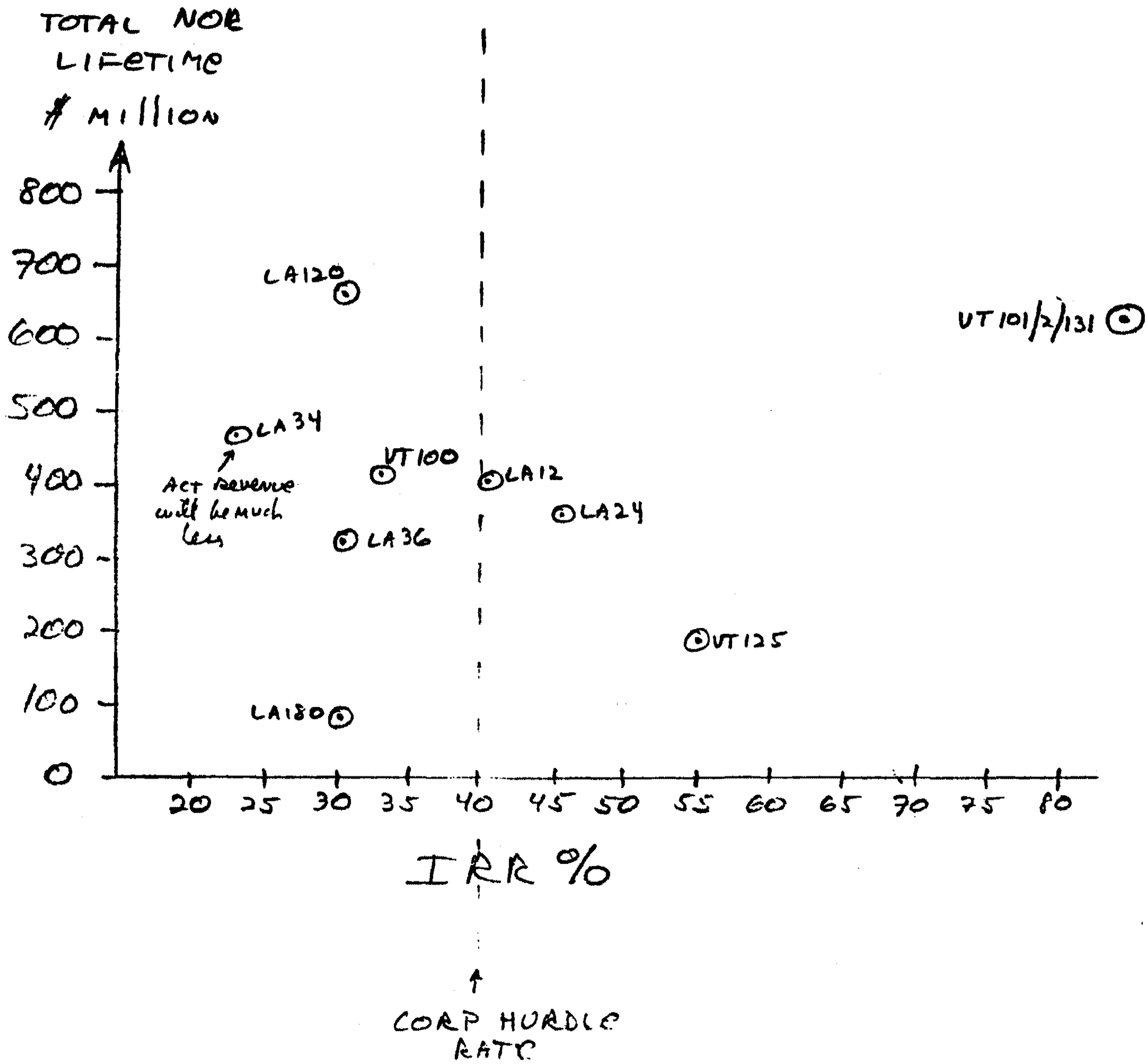


Issue - why should scarce ENG resources be going into low NOR products <u>even if</u> IRR is high?

D. Clinton

Source: Product Business Plans (BUAP)

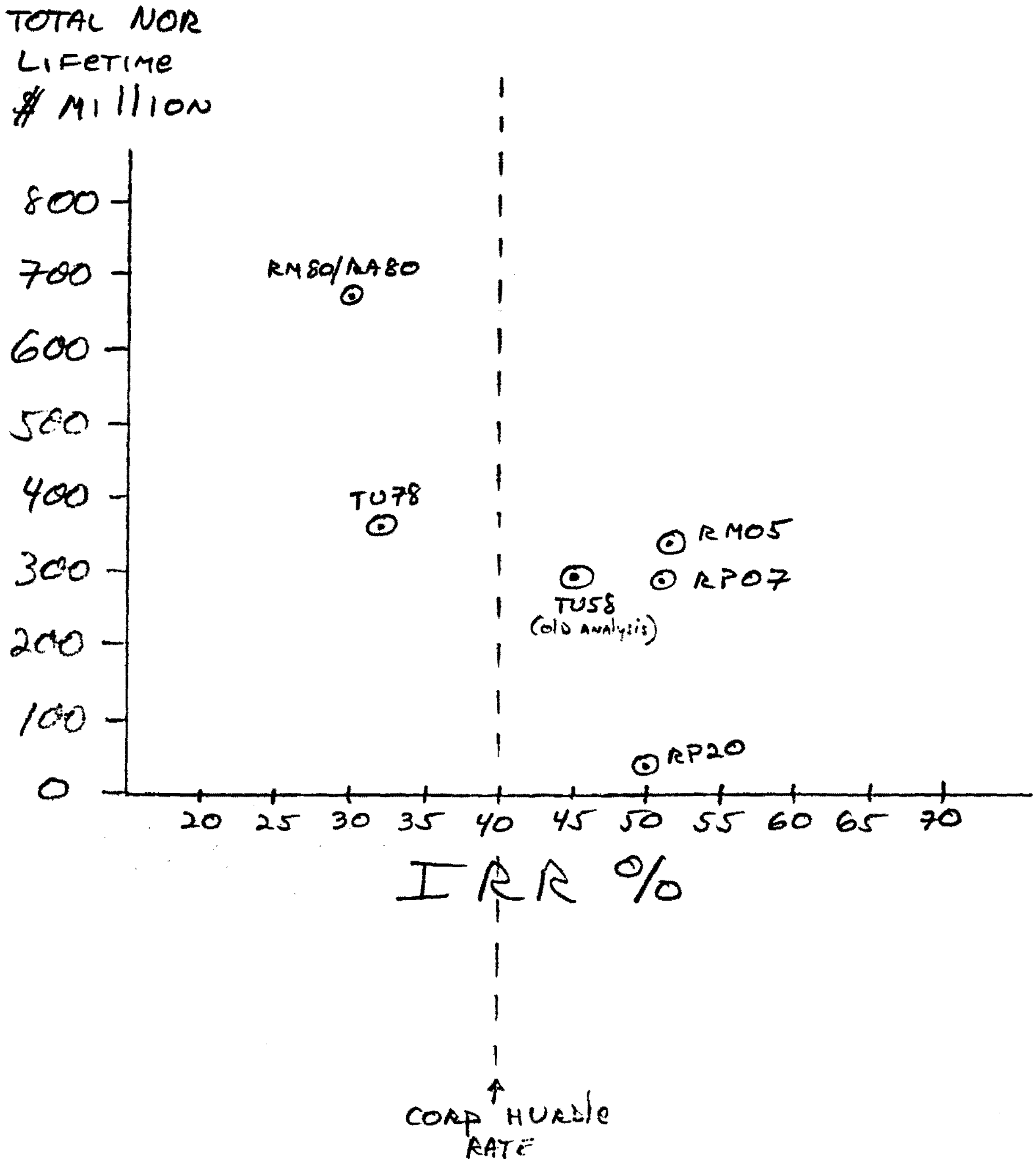
FINANCIAL METRICS
NOR vs IRR
TERMINALS



SOURCE: PRODUCT BUSINESS PLANS (BURP)

D.Clinton

FINANCIAL METRICS
NOR vs IRR
STORAGE



SOURCE: PRODUCT BUSINESS PLANS
(BURP)

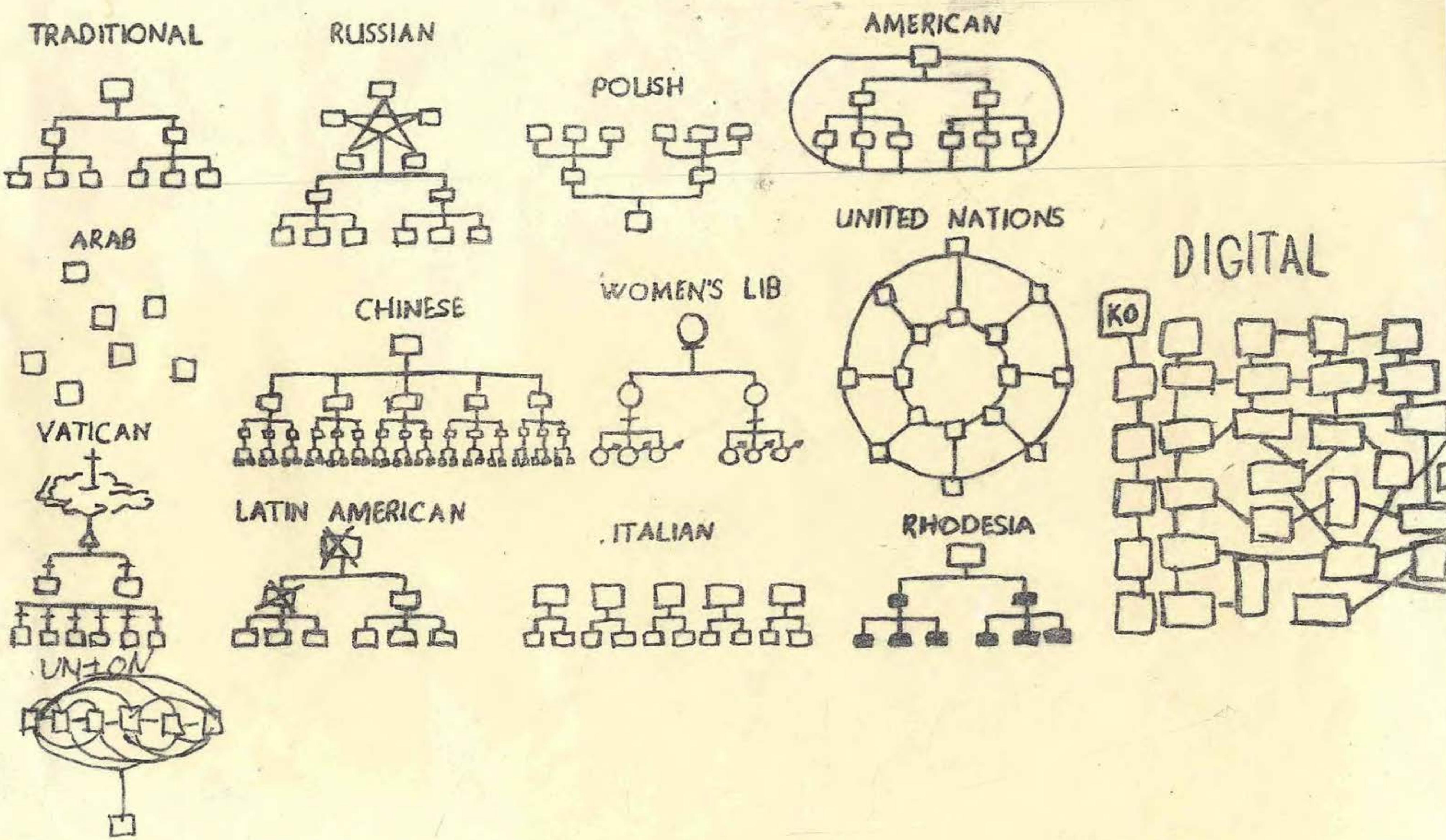
F) PG ENGINEERING EXPENDITURES

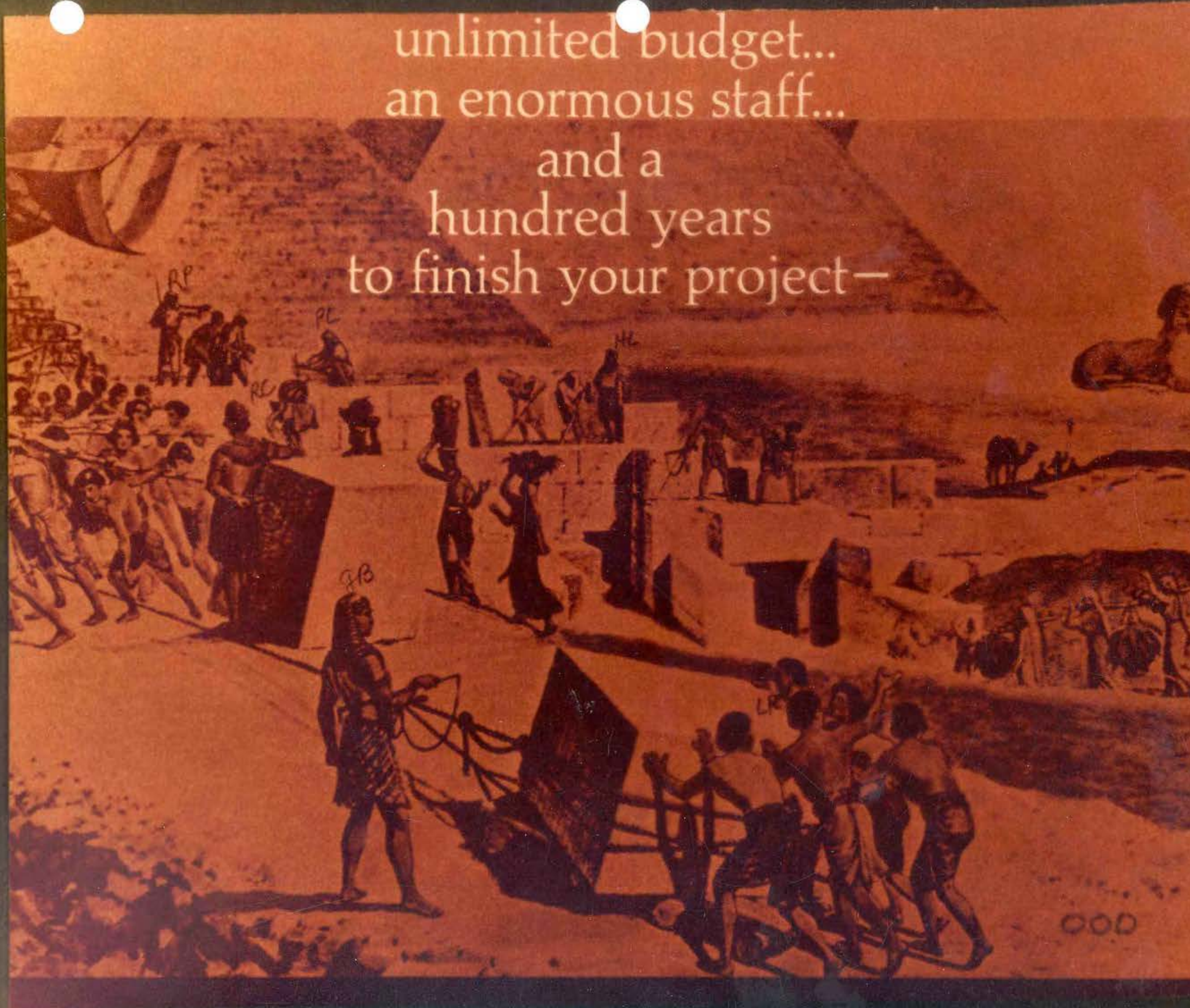
PRODUCT LINE ENGINEERING
FY82

	$ MILLIONS	PROJECTS
MSG	2	
LDP	6	
ECS	4	
ESG	2	
GSG	2	
TOEM	3	
TPL	1	
LCG	1	
GA	5	
CSI	1	
MDC	4	
COEM	5	
TIG	5	
A&SG	3	
MICROS	10	
TERM	5	
WP	7	
CSS	5	
RPG	4	
CS	2	
	===	
	$78M	

Observation: A significant amount (23%) of total Engineering activity is P/L funded.

ORGANIZATIONAL CHARTS




unlimited budget...
an enormous staff...
and a
hundred years
to finish your project—