Semiconductor Application Markets *Worldwide*

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Welcome to Dataquest

Semiconductor Application Markets *Worldwide*

You are in the *Source: Dataquest* binder

An annually updated collection of reference documents for the Semiconductor Application Markets *Worldwide* service. Worldwide and North American market statistics; *Company Backgrounders;* and several guides such as *How to Use Dataquest, Dataquest Research Methodology, Dataquest High-Technology Guide—Segmentation and Glossary* are contained in this binder.

Other Semiconductor Application Markets *Worldwide* service binders:

Dataquest Perspective
A series of multitopic publications that provide analysis on worldwide semiconductor application markets trends and issues and semiconductor news and views.

Semiconductor Application Markets *Worldwide*

Source: Dataquest

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Dataquest
a company of
The Dun & Bradstreet Corporation

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October 14, 1991

Attention: Clients of Semiconductor Application Markets service

For the last two years, we at Dataquest have been in the process of changing the format in which we deliver information to our clients. The Semiconductor Application Markets service began converting to the new format in May with the consolidation of our database information into individually bound booklets, instead of loose-leaf service sections. Now we are ready to tie the new look together with new binders and a new look to our newsletters.

The New Format

Dataquest's new publication format is simple, consisting of two parts:

> ***Dataquest Perspective*** -- a multitopic publication containing timely Dataquest analyses of markets, products, technologies, companies, end-user issues, and industry events. For fast retrieval of historical information, a quarterly year-to-date index will be issued at the beginning of each succeeding quarter.
>
> ***Source: Dataquest*** -- a collection of reference documents individually bound as booklets. These booklets include **guides** to Dataquest definitions and methods; **market statistics**, which are drawn from Dataquest's detailed databases; and **Company Backgrounders by Dataquest**, which are summaries of the companies representing the major portion of the market.

More than Just a Name Change!

The Semiconductor Application Markets service has been renamed:

Semiconductor Application Markets *Worldwide*

As the new name indicates, the service has been expanded to cover worldwide as well as North American application issues. The dynamics of specific electronic equipment markets, particularly the worldwide data processing market, are closely monitored.

The Specification

Following this letter is a summary specification for the Semiconductor Application Markets *Worldwide* service. If you have any questions regarding these changes, please call me at (408) 437-8624.

Sincerely,

Alice K. Leeper

Alice K. Leeper
Associate Director
Marketing

Semiconductor Application Markets *Worldwide*

Dataquest Perspective

Dataquest's Semiconductor Application Markets *Worldwide* service is a comprehensive market research service providing thorough forecasts and analyses of semiconductor consumption by end-use application markets. The service provides information on equipment manufacturers and electronic equipment markets, as well as detailed analyses of key fast-growing equipment segments.

A total of **twelve (12) monthly issues** will be published each year. In addition, **four special-edition issues** will be published each year, covering Dataquest's worldwide semiconductor forecast and worldwide market share analysis. The preliminary market share issue will publish January 1 each year. The final market share will publish no later than May 31 each year. The Dataquest Semiconductor Forecast issues will publish by May 31 and October 15 each year.

Source: Dataquest

This binder contains the reference documents for the Semiconductor Application Markets *Worldwide* service. These documents will be updated once or twice a year, depending on the subject. Included in this binder are guides, *Company Backgrounders by Dataquest*, and the following market statistics:

- Semiconductor Consumption and Shipment Forecast
- Worldwide and North American Electronic Equipment Production Forecast
- Worldwide and North American Semiconductor Consumption by Application Market Forecast
- North American OEM Revenue by Application
- Electronic Equipment Market Statistics

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October 14, 1991

SEMICONDUCTOR APPLICATION MARKETS
FILING INSTRUCTIONS

TITLE:	Worldwide And North American Electronic Equipment Production Forecast
TAB:	Electronic Equipment Forecast
FILING INSTRUCTIONS:	This booklet should be placed directly behind the tab entitled "Market Statistics" in your new "Source: Dataquest binder.
TITLE:	Company Backgrounders
TAB:	Company Backgrounders
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If you should have any questions please contact Kimberlie Southern at (408) 437-8320.

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Dataquest

Semiconductor Market Definitions

March 1992

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Semiconductor Application Markets *Worldwide*

Semiconductor Market Definitions

March 1992

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File behind the Guides tab inside the **Source: Dataquest** binder.

Published by Dataquest Incorporated

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March 1992

Semiconductor Market Definitions

March 1992

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Chapter 1

Market Share Survey Overview

Each year, Dataquest surveys semiconductor vendors in order to estimate their annual sales. The survey covers approximately 140 semiconductor vendors worldwide (this varies according to mergers, acquisitions, liquidations, start-ups, and so on) by 56 individual semiconductor product categories (excluding subtotals), 6 application segments, and 5 world regions (Europe is split into a further subregions). This exercise helps Dataquest maintain its dynamic database of semiconductor supply by company, and semiconductor shipments by world region and product. The information gained is supplemented by, and cross-checked with, Dataquest's various other information sources.

The semiconductor market share survey takes place twice each year. The first survey is to prepare preliminary estimates for the calendar year. This is then followed by a second survey of the same companies three months later in order to finalize estimates for the same calendar year. The first survey takes place during October and November. Our preliminary estimates are completed by the end of the calendar year under review, and the results are summarized in a research report (a *Dataquest Perspective* document), which is released on January 1 following the end of the year. Preliminary vendor rankings are featured in a Dataquest press release shortly after this date.

The second survey takes place during March. Our final semiconductor market share estimates are then published in greater depth in a reference report (a *Source: Dataquest* document) by May 31. There is usually minimal difference between preliminary and final rankings, as Dataquest makes every effort to ensure preliminary estimates are as accurate as possible. However, there will be occasions when some company results are revised according to unexpected late billings or order cancellations in the final months of the calendar year being reported.

The categories for which semiconductor revenue is reported are defined comprehensively for the purpose of clarity and guidance to survey participants. These definitions may occasionally be revised, altered or expanded to reflect changes in the industry. To support these definitions, Dataquest will issue an annual survey guide to all participants in its semiconductor market share survey program. This document comprises the 1991 survey guide.

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Chapter 2

Semiconductor Companies Surveyed Worldwide 1991

North American Companies

Actel
Advanced Micro Devices
Allegro MicroSystems
Altera
Analog Devices
Appian Technology
Applied Micro Circuits Corporation
AT&T
Atmel
Brooktree
Burr-Brown
California Micro Devices
Catalyst
Cherry Semiconductor
Chips & Technologies
Cirrus Logic
Comlinear
Crystal
Cypress Semiconductor
Dallas Semiconductor
Elantec
Exar
General Instrument
Gennum
Gould AMI
Harris
Hewlett-Packard
Honeywell
Hughes
IMI
Integrated Device Technology
Intel
International CMOS Technology
International Microelectronic Products
International Rectifier
ITT
Kulite
Lattice
Linear Technology
LSI Logic
Maxim
Micro Linear
Micro Power Systems
Microchip Technology
Micron Technology
Microsemi
Mitel
MOSel
Motorola
National Semiconductor
NCR
Novasensor Inc.
Optek
Performance Semiconductor
Powerex
Quality Technologies
Raytheon
Rockwell
SEEQ Technology
Semtech
Sierra Semiconductor
Silicon General
Silicon Systems
Siliconix
Sipex
Solitron
Standard Microsystems
Supertex
Tektronix
Teledyne
Texas Instruments
TRW
Unitrode
Universal
Vitelic
VLSI Technology
VTC
WaferScale Integration
Weitek
Western Digital
Xicor
Xilinx
Zilog

Japanese Companies

Fuji Electric
Fujitsu
Hitachi
Matsushita

Mitsubishi
NEC
New JRC
NMB Semiconductor
Oki
Ricoh
Rohm
Sanken
Sanyo
Seiko Epson
Sharp
Shindengen Electric
Sony
Toko
Toshiba
Yamaha

European Companies

ABB-HAFO
ABB-IXYS
Austria Mikro Systeme
Ericsson
Eupec
European Silicon Structures
Eurosil
Fagor
GEC Plessey
Matra-MHS
MEDL
Mietec
Philips Semiconductors
Semikron
SGS-Thomson
Siemens
STC
TAG
Telefunken Electronic
TMS
Zetex

Asia/Pacific Companies

Daewoo
Goldstar
Hualon Microelectronics Corporation
Hyundai
Korean Electronic Company
MOSpec
Samsung
Silicon Integrated Systems
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Summary

83 North American Companies
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Chapter 3

General Sales Definitions

1. **Sales to customer**. All sales are reported according to customer location, that is, the shipping destination.
2. **Finished semiconductor products**. Defined as assembled and tested semiconductor products. *Only count sales of finished semiconductor products to distributors and equipment manufacturers.* Do not include sales of finished semiconductors to other semiconductor vendors for value-added resale. Resale revenue will be estimated separately for these companies.
3. **Unfinished semiconductor products**. Defined as wafer and die foundry products. *Only count sales of unfinished semiconductor products to distributors and equipment manufacturers.* Do not include sales of unfinished semiconductors to other semiconductor vendors for resale. Resale revenue will be estimated separately for these companies.
4. **Internal semiconductor sales**. Defined as revenue from finished or unfinished semiconductor products from intracompany (internal or in-house) transfers to divisions and subsidiaries of your parent company that manufacture end equipment. *Include all such internal semiconductor sales at market price.*
5. **Hybrid products**. Defined as products that comprise a number of active semiconductor die and/or passive components in a single package. *Only count sales of hybrid products that conform with definition 2 or 3.*
6. **Modules and board-level products**. Defined as products that comprises a number of active semiconductor and/or passive components mounted on a single printed circuit board (PCB). Only count sales of modules and board-level products that conform with definition 2 or 3. *Only include the market value of the active semiconductors in the module or board-level product.*
7. **System-level products**. Defined as products that comprise a number of module and/or board-level products amounting to a single system or subsystem. Examples include development systems, hardware platforms, and box-level products. *Do not include any sales from such system-level products.*
8. **NRE charges**. Defined as nonrecurring engineering charges made to customers as the result of costs incurred during the design or customizing of a semiconductor device for that customer. This occurs in the following product areas:

   - Design charges for ASICs including gate arrays, cell-based ICs, and full-custom ICs.
   - Mask charges that result from the customizing of a programmable array logic (PAL), when the customer's fuse pattern is masked into it to produce a hard-wired array logic (HAL).
   - Mask charges that result from the customizing of ROMs.
   - Mask charges that result from the storage of the customer's microcode in a microcontroller.

   Only count revenue from NRE charges on active semiconductor products that conform with definition 2 or 3. Include these NRE charges as part of the revenue received from associated semiconductor product. Do not include revenue from NRE charges incurred during research, feasibility studies, or facility rental to third parties.
9. **Electronic design automation (EDA) software**. EDA software is used to automate the design of semiconductors. Dataquest includes revenue from ASIC semiconductor vendors that also sell their own EDA software. *Include any revenue derived from EDA software in the appropriate ASIC product category.* The applicable categories are PLD, gate array, and cell-based IC.

10. **IPR income.** Defined as intellectual property rights, income from royalties, licensing agreements, technology transfers, and dispute settlements. *Do not include any such IPR income.*

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Chapter 4

Exchange Rate Definitions

When converting a company's local currency sales into U.S. dollars, or vice versa, it is important to use the 1991 exchange rates provided below. This will prevent inconsistencies in the conversion of offshore sales between each company. These are the exchange rates that will be used in the final 1991 semiconductor market share survey. Exchange rates for historical years are available on request.

Average 1991 Exchange Rates against the U.S. Dollar

Country	1991 Rate	Currency
Austria	11.67	Schillings/$
Belgium	34.13	Belgian Francs/$
Denmark	6.39	Danish Kroner/$
Finland	4.04	Markka/$
France	5.64	French Francs/$
Germany	1.66	Deutsche Marks/$
Ireland	0.62	Pounds/$
Italy	1,238.93	Lire/$
Japan	134.68	Yen/$
Luxembourg	34.13	Luxem. Francs/$
Netherlands	1.87	Gulden/$
Norway	6.49	Norwegian Kroner/$
Portugal	144.02	Escudos/$
South Korea	730.90	Won/$
Spain	103.81	Pesetas/$
Sweden	6.04	Swedish Kronor/$
Switzerland	1.43	Swiss Francs/$
Taiwan	26.50	NT$/$
United Kingdom	0.57	Pounds/$
ECU	0.81	ECU/$

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Chapter 5

Semiconductor Product Category Hierarchy

The following semiconductor product category hierarchy begins with **total semiconductor**, and indents each subcategory in the left-hand column according to its position in the hierarchy. At each level in the hierarchy, all subcategories that contribute to this level are shown as a subcategory summation in the right-hand column. Any level in the hierarchy that does not depend on any subcategories is marked as a "Data Point."

Total Semiconductor:	**IC + Discrete + Optoelectronic**
Total Integrated Circuit:	Digital Monolithic Bipolar IC + Digital Monolithic MOS IC + Analog/Mixed-Signal Monolithic IC + Hybrid IC
Bipolar Digital IC:	1. Bipolar Digital TTL/Other IC + Bipolar Digital ECL IC—*technology split* 2. Bipolar Digital Memory IC + Bipolar Digital Microcomponent IC + Bipolar Digital Logic—*function split*
Bipolar Digital TTL/Other IC:	Data Point
Bipolar Digital ECL IC:	Data Point
Bipolar Digital Memory IC:	Data Point
Bipolar Digital Micro IC:	Data Point
Bipolar Digital Logic IC:	Bipolar Digital Application-Specific IC + Bipolar Digital Standard Logic IC + Other Bipolar Digital Logic IC
Bipolar Digital ASIC:	Bipolar Digital Gate Array + Bipolar Digital Programmable Logic Device + Bipolar Digital Cell-Based IC + Bipolar Digital Full-Custom IC
Bipolar Digital GA:	Data Point
Bipolar Digital PLD:	Data Point
Bipolar Digital CBIC:	Data Point
Bipolar Digital FCIC:	Data Point
Bipolar Digital Standard Logic IC:	Data Point
Other Bipolar Digital Logic IC:	Data Point
MOS Digital IC:	1. CMOS Digital IC + BiCMOS Digital IC + NMOS/Other Digital IC—*technology split* 2. MOS Memory IC + MOS Microcomponent IC + MOS Logic IC—*function split*
CMOS Digital IC:	Data Point
BiCMOS Digital IC:	Data Point
NMOS/Other Digital IC:	Data Point

MOS Digital Memory IC:	DRAM + SRAM + EPROM + Other Nonvolatile MOS Digital Memory IC + Other MOS Digital Memory IC
DRAM:	Data Point
SRAM:	Data Point
EPROM:	Data Point
Other NV MOS Memory IC:	Data Point
Other MOS Memory IC:	Data Point
MOS Digital Microcomponent IC:	MOS Digital Microprocessor + MOS Digital Microcontroller + MOS Digital Microperipheral
MOS Digital MPU:	Data Point
MOS Digital MCU:	Data Point
MOS Digital MPR:	Data Point
MOS Digital Logic IC:	MOS Digital Application-Specific IC + MOS Digital Standard Logic IC + Other MOS Digital Logic IC
MOS Digital ASIC:	MOS Digital Gate Array + MOS Digital Programmable Logic Device + MOS Digital Cell-Based IC + MOS Digital Full-Custom IC
MOS Digital GA:	Data Point
MOS Digital PLD:	Data Point
MOS Digital CBIC:	Data Point
MOS Digital FCIC:	Data Point
MOS Digital Standard Logic IC:	Data Point
Other MOS Digital Logic IC:	Data Point
Analog IC:	Monolithic Analog IC + Hybrid IC
Monolithic Analog IC:	Linear IC + Mixed-Signal IC
Linear IC:	Amplifier IC + Voltage Regulator IC + Voltage Reference IC + Comparator IC + Special Function IC + Special Consumer IC + Special Automotive IC + Linear Array ASIC
Amplifier IC:	Data Point
Voltage Regulator IC:	Data Point
Voltage Reference IC:	Data Point
Comparator IC:	Data Point
Special Function IC:	Data Point
Special Consumer IC:	Data Point
Special Automotive IC:	Data Point
Linear Array ASIC:	Data Point
Mixed-Signal IC:	Data Converter IC + Telecom IC + Interface IC + Switch/Multiplexer IC + Disk Drive IC + Mixed-Signal ASIC
Data Converter IC:	Data Point
Telecom IC:	Data Point

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Interface IC:	Data Point
Switch/Multiplexer IC:	Data Point
Disk Drive IC:	Data Point
Mixed-Signal ASIC:	Data Point
Hybrid IC:	Data Point
Total Discrete:	Transistor + Diode + Thyristor + Other Discrete
Transistor:	Small-Signal Transistor + Power Transistor
Small-Signal Transistor:	Data Point
Power Transistor:	Bipolar Power Transistor + MOS Power Transistor + Power Insulated Gate Bipolar Transistor (IGBT)
Bipolar Power Transistor:	Data Point
MOS Power Transistor:	Data Point
Power IGBT:	Data Point
Diode:	Small-Signal Diode + Power Diode
Small-Signal Diode:	Data Point
Power Diode:	Data Point
Thyristor:	Data Point
Other Discrete:	Data Point
Total Optoelectronic:	LED Lamp/Display + Optocoupler + CCD + Laser Diode + Photosensor + Solar Cell
LED Lamp/Display:	Data Point
Optocoupler:	Data Point
CCD:	Data Point
Laser Diode:	Data Point
Photosensor:	Data Point
Solar Cell:	Data Point

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Chapter 6

Semiconductor Product Category Definitions

The following semiconductor product category definitions begin with **total semiconductor**, and continue through each subcategory in the same order as shown in the preceding semiconductor product category hierarchy. At each level in the hierarchy, all subcategories that contribute to this level are shown as a subcategory summation in the right-hand column. Comprehensive definitions are given at every level.

Total Semiconductor:	(IC + Discrete + Optoelectronic.) Defined as an active semiconductor product that contains semiconducting material (such as silicon, germanium, or gallium arsenide) and reacts dynamically to an input signal, either by modifying its shape or adding energy to it. This definition excludes standalone passive components, such as capacitors, resistors, inductors, oscillators, crystals, transformers, and relays.
Total Integrated Circuit:	(Digital Monolithic Bipolar IC + Digital Monolithic MOS IC + Analog Monolithic IC + Hybrid IC.) An IC is defined as a large number of passive and/or active discrete semiconductor circuits integrated into a single package. A monolithic IC is one in which discrete circuits are integrated onto a single die, while a hybrid IC is one in which discrete circuits are integrated onto a small number of die.
Bipolar Digital IC:	1. *technology split*—(TTL/Other Bipolar IC + ECL) 2. *function split*—(Bipolar Digital Memory IC + Bipolar Digital Microcomponent IC + Bipolar Digital Logic IC) A bipolar digital IC is defined as a monolithic semiconductor product in which 100 percent of the die area performs digital functions, and concurrently, 100 percent of the die area is manufactured using bipolar semiconductor technology. A digital function is one in which data-carrying signals vary in discrete values.
TTL/Other Bipolar Digital IC:	Defined as a bipolar digital IC manufactured using transistor-transistor logic (TTL) semiconductor technology. Other bipolar technologies include resistor-transistor logic (RTL) and diode-transistor logic (DTL).
ECL IC:	Defined as a bipolar digital IC manufactured using emitter-coupled logic (ECL) semiconductor technology.
Bipolar Digital Memory IC:	Defined as a bipolar digital semiconductor product in which binary data are stored and electronically retrieved. Includes ECL random-access memory (RAM), read-only memory (ROM), programmable ROM (PROM), last-in/first-out (LIFO) memory, first-in/first-out (FIFO) memory.

Bipolar Digital Micro IC:	Defined as a bipolar digital semiconductor product that contains a data processing unit or serves as an interface to such a unit. Includes both complex-instruction-set computing (CISC) and reduced-instruction-set computing (RISC) processor architectures. Includes bipolar digital microprocessor (MPU), bipolar digital microcontroller (MCU), and bipolar digital microperipheral (MPR), where applicable.
Bipolar Digital Logic IC:	(Bipolar Digital Application-Specific IC + Bipolar Digital Standard Logic IC + Other Bipolar Digital Logic IC.) Defined as a bipolar digital semiconductor product in which more than 50 percent of the die area performs logic functions. Excludes bipolar digital microcomponent ICs.
Bipolar Digital ASIC:	(Bipolar Digital Gate Array + Bipolar Digital Programmable Logic Device + Bipolar Digital Cell-Based IC + Bipolar Digital Full-Custom IC.) Defined as a single-user bipolar digital logic IC that is manufactured using vendor-supplied tools and/or libraries. Do not include bipolar digital ASICs incorporating microcontroller cells, as these should be reported in the bipolar digital microcontroller IC category.
Bipolar Digital GA:	Bipolar Digital Gate Array is defined as an ASIC device that is customized by the vendor to end-user specification using layers of interconnect. Included in this category are generic or base wafers with embedded functions, for example, SRAM, EEPROM.
Bipolar Digital PLD:	Bipolar Digital Programmable Logic Device is defined as an ASIC device that is customized by the end user after assembly. Included in this category are bipolar field-programmable logic (bipolar FPL), bipolar field programmable gate array (bipolar FPGA), bipolar programmable array logic (bipolar PAL), bipolar programmable logic array (bipolar PLA), bipolar electrically programmable logic device (bipolar EPLD), and bipolar programmable multilevel logic device (bipolar PMD).
Bipolar Digital CBIC:	Bipolar Digital Cell-Based IC is defined as an ASIC device that is produced from a library of standard circuits/cells to a single-user specification. This process involves automatic routing and placement of cells. Included in this definition is bipolar standard cell IC. Excluded from this definition are cell-based ICs with processor cores. These should be reported under bipolar digital microcomponents.
Bipolar Digital FCIC:	Bipolar Digital Full-Custom IC is defined as an ASIC device that is produced for a single user using a full set of masks. This manufacturing process involves manual routing and placement of cells.
Bipolar Digital Standard Logic IC:	Defined as commodity bipolar family logic with less than 150 gates. Sometimes referred to as glue logic. Examples include TTL, ECL and other family logic: TTL-compatible SSI, MSI, LSI; standard, AS, FAST, LS, ALS lines; ECL-compatible SSI, MSI, LSI. Also RTL and DTL.

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Other Bipolar Digital Logic IC:	Defined as all other bipolar digital logic ICs not accounted for in the preceding categories. Includes bipolar commodity family logic with 150 or more gates, and bipolar digital general-purpose logic not belonging to any families.
MOS Digital IC:	1. *technology split*—(CMOS + BiCMOS + NMOS/Other) 2. *function split*—(MOS Digital Memory IC + MOS Digital Microcomponent IC + MOS Digital Logic IC) A MOS digital IC is defined as a monolithic semiconductor product in which 100 percent of the die area performs digital functions, and concurrently, any portion of the die area that is manufactured using metal oxide semiconductor (MOS) technology. A digital function is one in which data-carrying signals vary in discrete values. Includes mixed technology manufacturing, such as BiMOS and BiCMOS, where there is some MOS technology employed.
CMOS Digital IC:	Defined as a MOS digital IC manufactured entirely in complementary metal oxide semiconductor (CMOS) technology.
BiCMOS Digital IC:	Defined as a MOS digital IC manufactured using bipolar and complementary metal oxide semiconductor (CMOS) technologies.
NMOS/Other Digital IC:	Defined as a MOS digital IC manufactured entirely in N-channel metal oxide semiconductor (NMOS) technology. Other MOS technologies include P-channel metal oxide semiconductor (PMOS).
MOS Digital Memory IC:	(DRAM + SRAM + EPROM + Other Nonvolatile MOS Digital Memory + Other MOS Digital Memory.) Defined as a MOS digital IC in which binary data are stored and electronically retrieved.
DRAM:	Defined as Dynamic RAM, Multiport-DRAM (M-DRAM), and Video-DRAM (V-DRAM). DRAMs have memory cells consisting of a single transistor, and require externally cycled memory cell refreshes on a regular basis. These are volatile memories and addressing is multiplexed.
SRAM:	Defined as Static RAM, Multiport-SRAM (M-SRAM), Battery Backed-Up SRAM (BB-SRAM), and Pseudo SRAM (PSRAM). SRAMs have memory cells consisting of a minimum of four transistors, except PSRAM, which has a memory cell consisting of a single transistor and is similar to DRAM. SRAMs do not require externally cycled memory cell refreshes. These are volatile memories and addressing is not multiplexed (except in the case of PSRAM). Note that color palette DACs are included in the mixed-signal data converter category.
EPROM:	Defined as Erasable Programmable Read-Only Memory. Includes Ultraviolet EPROM (UV EPROM) and One-Time Programmable Read-Only Memory (OTP ROM). EPROMs have memory cells consisting of a single transistor, and do not require any memory cell refreshes. These are nonvolatile memories.
Other NV MOS Memory IC:	Includes EEPROM, flash memory, and mask ROM. These are all nonvolatile memories.

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	EEPROM is defined as Electrically Erasable Programmable Read-Only Memory. Includes Serial EEPROM (S-EEPROM), Parallel EEPROM (P-EEPROM), and Electrically Alterable Read-Only Memory (EAROM). EEPROMs have memory cells consisting of a minimum of two transistors, and do not require memory cell refreshes. Includes Nonvolatile RAM (NVRAM), also known as Shadow RAM. These semiconductor products are a combination of an SRAM and a P-EEPROM in each memory cell. The P-EEPROM functions as a shadow backup for the SRAM when power is lost. Flash memory is defined as rapidly electrically erasable nonvolatile memory. Includes flash memory based on an EPROM cell structure (that is, single transistor) and flash memory based on an EEPROM cell structure (that is, minimum of two transistors), and does not require memory cell refreshes. Includes flash memory based on single- or dual-voltage supply. Mask ROM is defined as Mask-Programmable Read-Only Memory. Specifically, a form of memory that is programmed by the manufacturer to a user specification using a mask step. Mask ROM is programmed in hardware rather than software.
Other MOS Digital Memory IC:	Defined as all other MOS digital memory not already accounted for in the preceding categories. Includes MOS digital content addressable memory (CAM), MOS digital cache-tag RAM, MOS digital first-in/first-out memory (FIFO), MOS digital last-in/first-out (LIFO) memory, ferroelectric memory.
MOS Digital Microcomponent IC:	(MOS Digital Microprocessor + MOS Digital Microcontroller + MOS Digital Microperipheral.) Defined as a MOS digital IC that contains a data processing unit or serves as an interface to such a unit. Includes both complex-instruction-set computing (CISC) and reduced-instruction-set computing (RISC) processor architectures.
MOS Digital MPU:	Defined as a MOS Digital Microprocessor. A semiconductor product serving as the central processing unit (CPU) of a system. Consists of an instruction decoder, arithmetic logic unit (ALU), registers, and additional logic. An MPU performs general-purpose computing functions by executing external instructions and manipulating data held in external memory. Includes MOS digital MPUs incorporating or developed from an ASIC design.
MOS Digital MCU:	Defined as a MOS Digital Microcontroller. A semiconductor product serving as a dedicated, or embedded controller in a system. Consists of an integral MPU, some nonvolatile memory containing end-user-specified instructions, and some volatile memory for temporary storage of code or data. An MCU can perform basic computing functions without support form microperipheral (MPR) products. This category also contains members of microcontroller product families that have had the on-chip nonvolatile memory removed and instead, access the end-user program contained in external nonvolatile memory. Includes MOS digital MCUs performing a standalone digital signal processing (DSP) function. Includes MOS digital MCUs incorporating or developed from an ASIC design.

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MOS Digital MPR:	Defined as a MOS Digital Microperipheral. A semiconductor product serving as a logical support function to an MPU or MCU in a system. An MPR provides enhancement of system performance and/or interface with external systems. Includes MOS digital MPRs comprising more than one device, such as PC chip sets. Examples of a MOS digital MPR include: timer, interrupt control, DMA, MMU, peripheral controllers (for example, disk, graphics display, CRT, keyboard controllers), communications controllers (for example, UART), chip sets for microprocessor support, LAN coprocessors, accelerator coprocessors (for example, floating-point unit, graphics coprocessor, image processor).
MOS Digital Logic IC:	(MOS Digital Application-Specific IC + MOS Digital Standard Logic IC + Other MOS Digital Logic IC.) Defined as a MOS digital IC in which more than 50 percent of the die area performs logic functions. Excludes MOS digital microcomponent ICs.
MOS Digital ASIC:	(MOS Digital Gate Array + MOS Digital Programmable Logic Device + MOS Digital Cell-Based IC + MOS Digital Full-Custom IC.) Defined as a single-user logic IC that is manufactured using vendor-supplied tools and/or libraries. Do not include ASICs incorporating microcontroller cells that should be included in microcontroller revenue.
MOS Digital GA:	MOS Digital Gate Array is defined as an ASIC device that is customized by the vendor to end-user specification using layers of interconnect. Included in this category are generic or base wafers with embedded functions, for example, SRAM, EEPROM.
MOS Digital PLD:	MOS Digital Programmable Logic Device is defined as an ASIC device that is customized by the end user after assembly. Included in this category are MOS field-programmable logic (MOS FPL), MOS field-programmable gate array (MOS FPGA), MOS programmable array logic (MOS PAL), MOS programmable logic array (MOS PLA), MOS electrically programmable logic device (MOS EPLD), and MOS programmable multilevel logic device (MOS PMD).
MOS Digital CBIC:	MOS Digital Cell-Based IC is defined as an ASIC device that is produced from a library of standard circuits/cells to a single-user specification. This process involves automatic routing and placement of cells. Included in this definition is MOS standard cell IC. Excluded from this definition are cell-based ICs with processor cores. These should be reported under MOS digital microcomponent.
MOS Digital FCIC:	MOS Digital Full-Custom IC is defined as an ASIC device that is produced for a single user using a full set of masks. This process involves manual routing and placement of cells.
MOS Digital Standard Logic IC:	Defined as commodity MOS family logic with less than 150 gates. Sometimes referred to as glue logic. Examples include: HC, HCT, AC, ACT, FACT, and 74BC BiCMOS family logic.

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Other MOS Digital Logic IC:	Defined as all other MOS digital logic ICs not accounted for in the preceding categories. Includes MOS commodity family logic with 150 or more gates, and MOS digital general-purpose logic not belonging to any families.
Analog IC:	(Monolithic Analog IC + Hybrid IC.) A monolithic analog IC is a semiconductor product that deals in the realm of electrical signal processing, power control, or electrical drive capability. It is one in which some of the inputs or outputs can be defined in terms of continuously or linearly variable voltages, currents, or frequencies. Includes all monolithic analog ICs manufactured using bipolar, MOS, or BiCMOS technologies. A monolithic IC is a single die contained in a single package. A hybrid IC is a semiconductor product that consists of more than one die contained in a single package. A hybrid IC may perform 100 percent linear, 100 percent digital, or mixed-signal (both linear and digital) functions. Note that hybrid digital ICs are reported in this category, and not under the earlier category of monolithic digital ICs. Includes all hybrid ICs manufactured using bipolar, MOS, or BiCMOS technologies.
Monolithic Analog IC:	(Monolithic Linear IC + Monolithic Mixed-Signal IC.) Monolithic linear IC is defined as an analog device that has only analog I/O, therefore its characteristics are inherently linear. Monolithic mixed-signal IC is defined as an analog device that has both analog and digital I/O (see mixed-signal IC definition).
Monolithic Linear IC:	(Amplifier IC + Voltage Regulator IC + Voltage Reference IC + Comparator IC + Special Function IC + Special Consumer IC + Special Automotive IC + Linear Array ASIC.) Defined as an analog device that has 100 percent analog I/O.
Amplifier IC:	Defined as a general-purpose linear IC that provides a voltage or current gain to an input signal. Includes operational amplifiers (mono, dual, quad, and so on), instrumentation amplifiers, buffer amplifiers, and power amplifiers. Consumer-dedicated amplifier ICs are counted in special consumer IC. Amplifier ICs designed specifically for one customer using vendor-supplied tools and/or libraries are counted in analog/mixed-signal ASIC.
Voltage Regulator IC:	Defined as a general-purpose linear IC that outputs a variable current at a regulated DC voltage to other circuits from a variable current and voltage input. Regulator ICs are either linear regulators in which the device provides an input-to-output voltage drop, or switching regulators, in which the device provides switched quantities of power to a smoothing circuit to gain higher efficiency and reduce power dissipation.
Voltage Reference IC:	Defined as a general-purpose linear IC that outputs a precise reference voltage to other circuits from a variable voltage input. A reference IC differs from a regulator IC in that it is not expected to power other circuits. In fact, voltage regulator ICs incorporate a voltage reference circuit.

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Comparator IC:	Defined as a general-purpose linear IC that compares two analog signal inputs and provides a single logic bit output. Although the output could be considered digital, these products are classed as linear ICs because they are specialty high-gain amplifiers, used in an open loop mode, and for which the output is constrained to only two states. By using a comparator, an unknown voltage can be compared with a known reference voltage.
Special Function IC:	Defined as either general-purpose linear ICs that do not fit into the other categories, or market/application-specific linear ICs for which a category does not yet exist. The main products that fall into this category include timers, phase-locked loops (PLLs), voltage-controlled oscillators (VCOs), signal/function generator ICs, and analog multipliers. Disk-drive analog ICs should be reported in their dedicated category under mixed-signal analog.
Special Consumer IC:	Defined as a general-purpose linear IC that is dedicated to general consumer applications, but is not application-specific. Includes analog ICs implemented in audio, video, radio, speech synthesis and recognition, electronic games, personal and home appliances, and electronic cameras. Consumer ICs designed specifically for one customer using vendor-supplied tools and/or libraries are counted in linear array ASIC or mixed-signal ASIC.
Special Automotive IC:	Defined as a linear IC that is used in the following applications: entertainment, engine control, safety, traction, and in-car electrical and suspension systems.
Linear Array ASIC:	Defined as a single-user linear IC that is manufactured using vendor-supplied tools and/or libraries. Linear arrays fall into one of three types, as follows: 1. Arrays of discrete-level cells such as transistors, diodes, and transistors 2. Arrays of discrete device combinations referred to as tiles 3. Arrays of higher-level functional macro cells such as operational amplifiers, comparators, VCOs, references, and other analog functions. These arrays are interconnected with a metal mask or by means of some user-programmable interconnect scheme. Unlike cell-based designs, they do not have a unique set of masks for all layers.
Mixed-Signal IC:	(Data Converter IC + Telecom IC + Interface IC + Switch/Multiplexer IC + Disk Drive IC + Mixed-Signal ASIC.) Defined as an analog IC that carries information in both digital (numeric) and signal/power forms. An IC is considered mixed-signal if it has both analog I/O and digital I/O pins. This definition is not based on the comparative size of the IC's analog and digital circuitry. It is a definition based on external pin functionality. ICs that are mainly digital but have some nominal analog housekeeping functions such as voltage monitors, power-on reset, or clock oscillators are not considered to be mixed-signal because there is no analog signal being received by or sent from the active component.

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Data Converter IC:	Defined as a general-purpose mixed-signal IC that converts an analog signal into a digital signal, or vice versa. Includes analog-to-digital converters (ADCs), digital-to-analog convertors (DACs), comparators, sample-and-hold circuits (SHCs), voltage-to-frequency circuits (VFCs), frequency-to-voltage circuits (FVCs), synchro-to-digital circuits (SDCs), and digital-to-synchro circuits (DSCs). All these are general-purpose data convertor ICs. *Also included in this category are color-palette DACs.* Consumer-dedicated data converter ICs are counted in special consumer IC. Data converter ICs designed specifically for one customer using vendor-supplied tools and/or libraries are counted in analog/mixed-signal ASIC.
Telecom IC:	Defined as a general-purpose mixed-signal IC used for voice band communication or data communication over voice band media. This category includes CODECs, combos and SLACs, SLICs, modem and fax/modem ICs, dialler and ringer ICs, repeaters, cellular communications ICs, ISDN ICs, telecom filter ICs, and other telecom-specific circuits. Telecoms ICs designed specifically for one customer using vendor-supplied tools and/or libraries are counted in linear array ASIC or mixed-signal ASIC.
Interface IC:	Defined as a general-purpose mixed-signal IC that serves as an interface between a digital system and other external nonsemiconductor systems. Includes line drivers, peripherals drivers, display drivers, keyboard encoders, receivers, transmitters, and transceivers. Consumer-dedicated interface ICs are counted in special consumer ICs. Interface ICs designed specifically for one customer using vendor-supplied tools and/or libraries are counted in linear array ASIC or mixed-signal ASIC.
Switch/Multiplexer IC:	Defined as a mixed-signal IC that digitally controls analog transmission gates. These products connect or disconnect the analog signal path in analog circuits. Analog switches operate in a mode where each switch is operated independently by a single logic bit. Multiplexers are multiple analog switches that are connected in a dependent manner, where only one signal path is connected through to the output depending on the state of a digital address word (greater than one bit). Thus, analog multiplexers are really addressable signal selector switches that select one-out-of-many signals for further analog processing. Because these addressable analog switches were the key element in time-division multiplexing, the term "multiplexer" has remained. They are an important part of the data conversion product family in that they are used to provide time-division multiplexing of signal inputs to a fast analog-to-digital converter.
Disk Drive IC:	Defined as a mixed-signal IC that is designed specifically for the rotating mass storage market. Applications include the read/write path from preamp up to the ENDEC, head positioning controller, and spindle motor control.
Mixed-Signal ASIC:	Defined as a mixed-signal analog IC that is manufactured for a single user, using vendor-supplied tools and/or libraries.

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Hybrid IC:	Defined as a semiconductor product consisting of more than one die contained in a single package. May perform digital, analog, or mixed-signal functions. May be manufactured using bipolar, MOS, or BiCMOS technology. Includes hybrid implementation of all monolithic IC functions described in the preceding categories.
Total Discrete:	(Transistor + Diode + Thyristor + Other Discrete.) A discrete semiconductor is defined as a unit building block performing a fundamental semiconductor function.
Transistor:	(Small-Signal Transistor + Power Transistor)
Small-Signal Transistor:	Defined as signal transistors, RF microwave transistors, dual transistors, MOS field-effect transistors (MOS-FETs), conductivity modulated field-effect transistors (COMFETs), insulated gate bipolar transistors (IGBTs), and MOS-bipolar transistors (MBTs). All rated below 1W power dissipation, 1A current rating, or 100V operating voltage.
Power Transistor:	(Bipolar Power Transistor + MOS Power Transistor + Power IGBT.) All rated 1W power dissipation and above, 1A current rating and above, or 100V operating voltage and above.
Bipolar Power Transistor:	Defined as bipolar Darlington transistor, bipolar microwave transistor, bipolar radio frequency (RF) transistor.
MOS Power Transistor:	Defined as MOS field-effect transistor (MOS-FET), MOS Darlington transistor, MOS microwave transistor, MOS radio frequency (RF) transistor.
IGBT Power Transistor:	Defined as insulated gate bipolar transistor (IGBT). Also includes conductivity modulated field-effect transistor (COMFET), MOS-bipolar transistor (MBT), and GEMFET.
Diode:	(Small-Signal Diode + Power Diode)
Small-Signal Diode:	Defined as signal diodes, Schottky diodes, zener diodes, switching diodes, voltage reference diodes, voltage regulator diodes, and rectifier diodes. All rated below 0.1A.
Power Diodes:	Defined as zener diodes and rectifier diodes. All rated 0.1A and above.
Thyristor:	Defined as thyristors, silicon-controlled rectifiers (SCRs), diacs, and triacs. Also includes solid-state relays (SSRs) incorporating triacs, thyristors, resistors, and capacitors.
Other Discrete:	Defined as all other discrete semiconductor products not accounted for in the preceding categories. Includes microwave diodes, varactors, tuning diodes, tunnel effect diodes, and selenium rectifiers.

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Total Optoelectronic:	(LED Lamp/Display + Optocoupler + CCD + Laser Diode + Photosensor + Solar Cell.) Defined as a semiconductor product in which photons induce the flow of electrons, or vice versa. Other functions may also be integrated onto the product. This category does not include LCD, incandescent displays, fluorescent displays, cathode ray tubes (CRTs), or plasma displays.
LED Lamp/Display:	LED Lamp + LED Display. An LED lamp is defined as a light-emitting diode: a semiconductor product consisting of a single die in which photons are emitted at frequencies dependent upon the semiconductor material employed. An LED display is defined as an array of LEDs: a semiconductor product consisting of more than one die in which photons are emitted at frequencies dependent upon the semiconductor material employed.
Optocoupler:	Defined as an optocoupler or optoisolator. A semiconductor product consisting of an LED separated from a photosensor by a transparent, insulating, dielectric layer. These are mounted inside an opaque package. Includes optointerrupters, in which the separation between LED and photosensor is large enough to allow external physical systems to influence the device.
CCD:	Defined as a charge-coupled device. A semiconductor product consisting of an array of photodiodes, an analog CCD shift register, and an output circuit. Includes linear array CCDs with serial shift registers and area array CCDs with parallel shift registers. Includes charge injection device (CID), charge-coupled photodiode (CCP), charge-priming device (CPD), self-scanning photodiode (SSP).
Laser Diode:	Defined as a diode that produces coherent light. A semiconductor product in which the heterojunction structure stimulates light amplification by stimulated emission of radiation (laser), resulting in coherent light. Includes Fabrey-Perot laser diodes, pulsed laser diodes, and phase-shifted laser diodes.
Photosensor:	Photodiode + Phototransistor. Defined as a diode or transistor in which photons are used to affect current flow.
Solar Cell:	Defined as photovoltaic or solar cells. A semiconductor device in which photons are used to generate current flow.

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Chapter 7

Worldwide Geographical Region Definitions

North America

Includes *United States* (50 states: Illinois, Indiana, Michigan, Ohio, Wisconsin, Alabama, Kentucky, Mississippi, Tennessee, Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, New Jersey, New York, Pennsylvania, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, Alaska, California, Hawaii, Oregon, Washington, Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Arkansas, Louisiana, Oklahoma, Texas), Puerto Rico, and *Canada* (12 provinces: Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, Labrador, Northwest Territories).

Japan

Includes Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shihoku, and Kyushu.

Europe

Includes *Benelux* (Belgium, Netherlands, Luxembourg), *France, Italy, Scandinavia* (Denmark, Finland, Norway, Sweden, Iceland), *United Kingdom and Eire* (England, Wales, Scotland, Northern Ireland, Republic of Ireland), *Germany* (including former east Germany), and *Rest of Europe* (Austria, Gibraltar, Greece, Liechtenstein, Malta, Monaco, Portugal, San Marino, Spain, Switzerland, Turkey, Andorra, Vatican City).

Asia/Pacific

Includes *East Asia* (China, Hong Kong, Macau, North and South Korea, Taiwan), *South Asia* (Bangladesh, Myanmar, India, Nepal, Maldives, Pakistan, Sri Lanka, Bhutan), *Southeast Asia* (Brunei, Timor, Indonesia, Kampuchea, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam, Borneo, Sumatra, Sulawesi, Java).

Rest of World

Includes Mexico, Arctic, Antarctica, Greenland, St. Pierre and Miquelon, *Australia, New Zealand* (North Island, South Island, Stewart Island), Tasmania, Christmas Island, Cocos Islands, New Zealand, Norfolk Island, *Oceania* (American Samoa, Canton and Enderbury Islands, Fiji, French Polynesia, Guam, Johnson Island, Kiribati, Midway Islands, Nauru, New Caledonia, Niue, Pacific Islands, Papua New Guinea, Pitcairn, Samoa, Solomon Islands, Toelau, Tonga, Tuvalu, Vanuatu, Wake Island, Wallis and Futuna Islands, New Britain, New Ireland, Admiralty Islands), *Africa* (Algeria, Libya, Egypt, Morocco, Mauritania, Mali, Senegal, Guinea, Sierra Leone, Liberia, Ghana, Ivory Coast, Togo, Benin, Nigeria, Niger, Chad, Sudan, Ethiopia, Central African Republic, Somalia, Zimbabwe, Uganda, Gabon, Cameroon, Congo, Zaire, Tanzania, Zambia, Malawi, Kenya, Cabinda, Namibia, Botswana, Mozambique, Rwanda, Burundi, South Africa, Swaziland, Benin, Equatorial Guinea, Burkina Faso, Djibouti, Lesotho, Ciskei, Transkei, Bophuthatswana, Venda), Madagascar, Mauritius, Comores, Réunion, *Central America* (Nicaragua, Panama, Guatemala, El Salvador, Belize, Honduras, Granada, Costa Rica), *South America* (Brazil, Chile, Uruguay, Paraguay, Argentina, Colombia, Peru, Bolivia, Venezuela, Guyana, Surinam, French Guiana, Equador, Falkland Islands), *Caribbean Islands* (Cuba, Jamaica, Haiti, Dominican Republic, Anguilla, Montserrat, Trinidad, Tobago, Dominica, Guadeloupe, Saint Lucia, Barbados, Martinique, Grenadine Islands, Bermuda, Bahamas, New Providence, Saint Vincent and The Grenadines, Saint Croix, Antilles), *Eastern Europe* (Albania, Bulgaria, Czechoslovakia, Hungary, Poland, Yugoslavia, Romania, Estonia, Latvia, Ukraine,

Belorussia, Lithuania, Latvia, Georgia), *Commonwealth of Independent States* (formerly USSR: Russian Federation, Moldavia, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Tadjikistan, Kirghizia, Turkmenistan), *Inner Asia* (Afghanistan, Bhutan, Mongolia, Pakistan), *Middle East* (Bahrain, Cyprus, Democratic Yemen, People's Republic of Yemen, Egypt, Gaza Strip, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, United Arab Emirates, Syria).

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Chapter 8

Semiconductor Application Segment Definitions

Data Processing

Defined as computer systems, terminals, smart cards, data storage devices, input/output devices, and dedicated systems:

- *Computer systems* includes supercomputers, mainframe computers, superminicomputers, minicomputers, microcomputers, workstations, personal computers.
- *Data storage devices* includes flexible/removable disk drives, fixed/rigid disk drives, optical disk drives, tape drives (streamers).
- *Terminals* includes alphanumeric terminals, graphics terminals, point-of-sales terminals, funds transfer terminals.
- *Smart cards* includes credit cards or credit card–size devices with one or more integrated circuits such as token cards, entry key cards, bank cards, medical cards, computer peripheral cards.
- *Input/output devices* includes dot matrix printers, thermal printers, ink jet printers, fully formed printers, page printers, other input/output devices such as monitors, key-entry equipment, media-to-media data conversion, magnetic ink character recognition, optical scanning equipment, plotters, voice recognition/synthesizer computer equipment, mice, keyboards, digitizers.
- *Dedicated systems* includes office equipment such as copiers, duplicators, full-color copiers, electronic calculators, dictating/transcribing equipment, electronic typewriters, word processors, banking systems and cash registers, mailing/letter-handling/addressing equipment.

Communication

Defined as premise telecom equipment, public telecom equipment, radio, and broadcast and studio:

- *Premise telecom equipment* includes image and text communication such as facsimile, video conferencing, telex, videotex, CCTV; data communications equipment such as modems, statistical multiplexers, time-division multiplexers, local area networks (LANs), private packet data switching; PBX/key telephone systems; call processing equipment such as answering machines, attendant consoles, automatic call distributors (ACDs), voice response units (VRUs), voice terminals, voice messaging systems, call management systems; desktop terminal equipment such as standard telephones, cordless telephones, cellular telephones, video telephones, answering machines.
- *Public telecom equipment* includes transmission equipment, central office switching, public packet switching, and mobile communication such as mobile radio base stations, pagers, base stations.
- *Radio* includes communications equipment transmitting and receiving sound through the use of electronic waves/signals.
- *Broadcast and studio* includes all electronic equipment used to make information public by means of radio and television.

Consumer Appliances

Defined as audio equipment, video equipment, personal electronics, and electronic/electrical:

- *Audio equipment* includes compact disc players, radio combinations, stereo hi-fi components: amplifiers, preamplifiers, tuners, cassette decks, graphic equalizers, turntables, speakers, and equipment used in studio, broadcast, and home environments (equipment that interprets frequencies corresponding to audible sound waves), musical instruments.
- *Video equipment* includes video cameras, video camcorders, videocassette recorders, videotape recorders, color televisions, black-and-white televisions.
- *Personal electronics* includes watches, clocks.
- *Electronic/electrical appliances* includes air conditioners, microwave ovens, washers and dryers, refrigerators/freezers, dishwashers, ranges, ovens.

Industrial

Defined as security/alarm management, manufacturing systems, test equipment, process control equipment, robot systems, automated material handling, instrumentation, medical equipment, vending machines, laser equipment, power supply, traffic control, industrial and scientific research equipment, and other industrial electronic equipment such as vending machines, laser systems, teaching machines, and aids.

Military and Civil Aerospace

Defined as *military electronic equipment* and *civil aerospace*. This includes radar, military/civil sonar, missile weapon, space military equipment, military/civil navigation, communication, electronic warfare, reconnaissance, aircraft systems, military computer systems, military simulation and training, miscellaneous military equipment, civilian space, civil aircraft flight systems, and miscellaneous avionic equipment.

Transportation

Defined as in-car entertainment systems, body control electronics, driver information, powertrain, and safety and convenience electronics:

- *In-car entertainment* includes FM/AM radio, cassette, compact disc player, radio cassette combination systems, two-way radio communications systems, CB radio.
- *Body control electronics* includes vehicle controls such as four-wheel steering control, 2WD/4WD control, multiplex systems such as driver's door, auto-climate control, door locks, windshield wipers, heated rear windows, memory seats, remote security systems, steering wheel, other multiplex systems; lighting controls including automatic headlight systems, timers, reminders, sequential signal controls, other lighting controls; other body electronics including aerodynamic aid control, power roof/window controls, other body electronics.
- *Driver information* includes electronic dashboard/instrument clusters, analog or digital clusters, electronic analog/digital clocks and compasses, electronic thermometers, head-up displays, navigation and location systems, signal and warning lights.
- *Powertrain* controls include engine management systems, powertrain sensors, ignition control, fuel injection systems, fuel flow, engine temperature, air temperature, coolant level, and wheel speed sensors.
- *Safety and convenience* includes air purifier systems, airbag control systems, antilock braking systems (ABS), active suspension, collision avoidance systems, collision warning systems, cruise control, suspension control and traction control; and other safety and convenience systems.

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Chapter 1

A Guide to Help You Get the Most Out of Your Dataquest Information Resources

Introduction

As a Dataquest client, we want you to obtain the greatest possible value from your subscription. This guide will acquaint you with the available information resources and will help you establish a "user strategy" that ensures that Dataquest's products and services contribute to your success.

This guide is divided into the following sections:

- Your Industry Service: What's in It for You?
- How to Use Your Industry Service
- Customizing Your Industry Service
- Whom Do You Call at Dataquest?
- About Dataquest
- Subscription Terms
- Appendixes
  - Appendix A: Dataquest Information Resource Center CD-ROMS and Computer Databases
  - Appendix B: Dataquest 1991 Conference Schedule
  - Appendix C: Technology Products

Chapter 2

Your Industry Service: What's in It for You?

Clients can tap into Dataquest's extensive knowledge base to support their decision-making process in the industries and markets that we track. The information and analysis that you receive from Dataquest can help you to better:

- Evaluate markets
- Position new products
- Develop marketing strategies
- Perform competitive analysis
- Understand end-user trends
- Verify critical market assumptions
- Assess emerging technologies
- Implement and execute tactical plans
- Support your ongoing research activities

As a Dataquest client you will receive much of this information automatically through the regular publication of database documents and industry analysis. Your industry service also provides information, available at your initiation, that is specific to your company's needs. You will receive Dataquest information through a variety of forms, including:

- *Source: Dataquest*
- *Dataquest Perspectives*
- Inquiry support
  - Industry Analysts
  - Client Inquiry Centers
- Dataquest Information Resource Center

Source: Dataquest

The *Source: Dataquest* binder is an annually updated collection of reference documents. The binder contains worldwide and regional market statistics, *Company Backgrounders,* and several guides.

Guides

- *How to Use Dataquest:* Describes your industry service subscription, publications, inquiry privileges, phone contacts, library use, and other services.
- *High-Technology Guide—Segmentation and Glossary:* Lists key terms and defines the market segments, products, applications, regions, distribution channels, and environments tracked by Dataquest.
- *Dataquest Research Methodology:* Details the research methodology used by Dataquest to gather data and information and provides the general assumptions used to generate industry forecasts.

Market Statistics

Market Statistics documents provide clients with detailed tables consisting of product shipments, average selling prices, industry revenue, forecasts, and market share data.

Company Backgrounders

Each service provides its clients with a set of *Company Backgrounders by Dataquest,* made up of companies that represent 80 percent of the revenue of that industry. *Company Backgrounders* are produced by the Strategic Company Analysis group in Research Operations. The documents contain useful information on a company's finances, product lines, sales and manufacturing locations, and joint ventures, mergers, and acquisitions.

Dataquest Perspective

This multitopic publication, delivered on average twice a month, contains timely analysis of markets, products, technologies, companies, and industry events, and provides detailed discussions of our market projections and market share statistics. These publications are filed

chronologically, and include a quarterly index that cross-references articles by company name and major topic. They may be supplemented as needed by the timely delivery of faxes that provide information and analysis of current significant events.

Please note that all of Dataquest's written material is copyrighted and therefore may not be copied without our permission.

Inquiry Support

Inquiry—via phone, fax or letter—is an integral part of the service Dataquest provides. Through inquiry you can:

- Clarify or interpret information.
- Explore Dataquest information in more depth.
- Discuss the application of this information to a particular situation.
- Access information that is not available in Dataquest publications, but is available in Dataquest's extensive files.

Each Dataquest client has a designated binderholder. In addition to receiving all the Dataquest published materials, the binderholder serves as the liaison between Dataquest and your company.

The binderholder has access to Dataquest's inquiry privilege and may designate up to two people to serve as alternates for inquiry privileges. Dataquest account managers need to be aware of any designated alternates.

If someone calls who is not a binderholder or alternate, Dataquest will refer that person to the account manager for your company. We have a commitment to our clients to provide them with timely, high-value information. In order to do that, services must be restricted to authorized contacts.

Call Your Industry Analyst

Industry analysts have significant industry expertise. Directly or through the assistance of Client Inquiry Center (CIC) personnel, you have access to the industry analysts associated with your service. This access is on an as-required basis relative to those markets, products, and technologies within the scope of your service. Analysts may be called directly when you know exactly what you need and who at Dataquest can provide the information.

Call the Client Inquiry Center

Many of Dataquest's services provide a Client Inquiry Center (Enquiry Desks for European customers). These centers are responsible solely for the quick turnaround of your fact-based questions. CIC personnel have access to industry service publications and database information, and they are trained to help you locate information within your Dataquest service. CIC personnel will also put you in touch with appropriate industry analysts when you require in-depth analysis of issues and trends, or opinion about the implications of recent industry events. The CIC may be called when you need an answer to a fact- or data-related question, when you need a backup to your regular analysts should they not be available, or when you need direction to new areas as your questions develop.

Dataquest is committed to personally handling each of your calls. Figure 2-1 illustrates how inquiries in the CIC are handled. We will ensure that you are put in touch with the right individual, or if you wish, you may choose to leave a voice-mail message when a particular analyst is not immediately available.

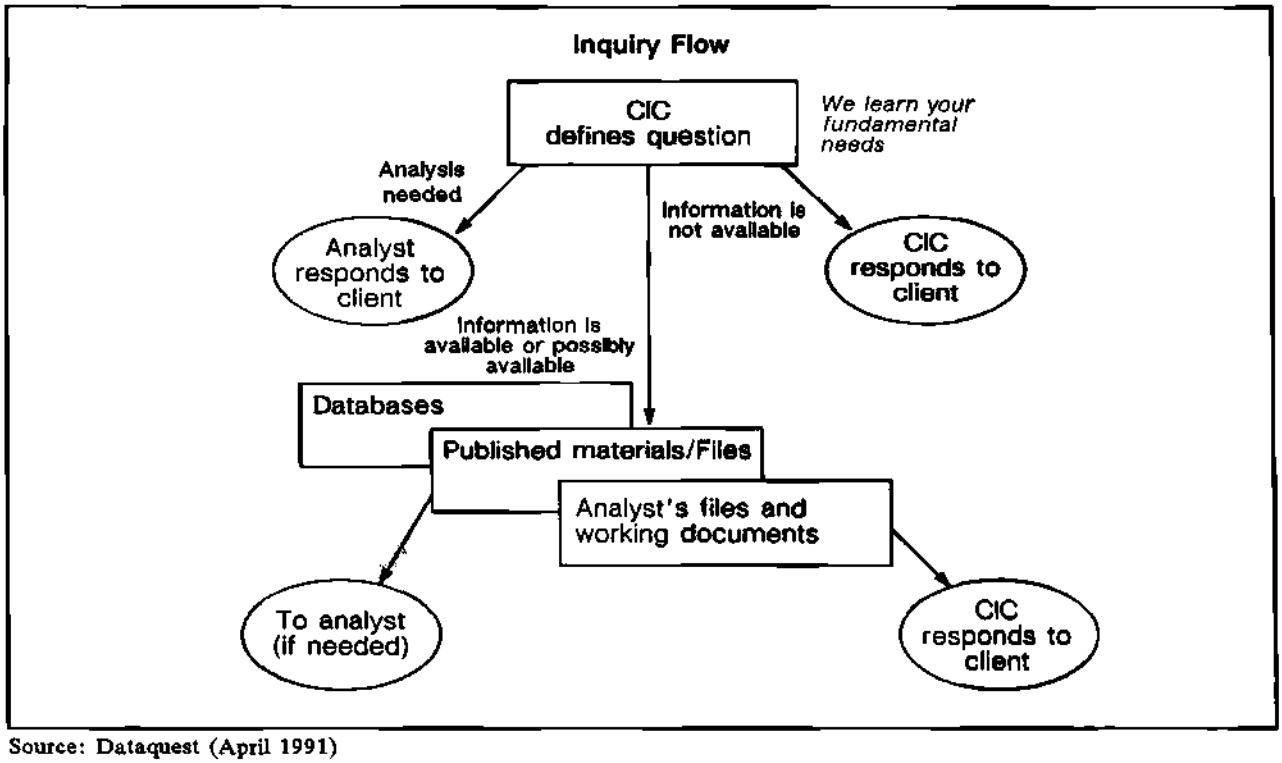
The more Dataquest knows about your inquiry, the better we will be able to help you. When you call with a question, the CIC will want to know:

- What information you already have on the subject
- What related information you are gathering
- How you plan to use the information
- What you are trying to demonstrate

It will also help us to know what stage of the market research process you are in, as well as the depth of information you require. The more we know, the better we will be able to offer additional or related information, or offer insights into different ways to approach the question. Of course, tell us only what you are comfortable with—we don't need or want to know proprietary information. Figure 2-2 shows the mix of people available to respond to your inquiries.

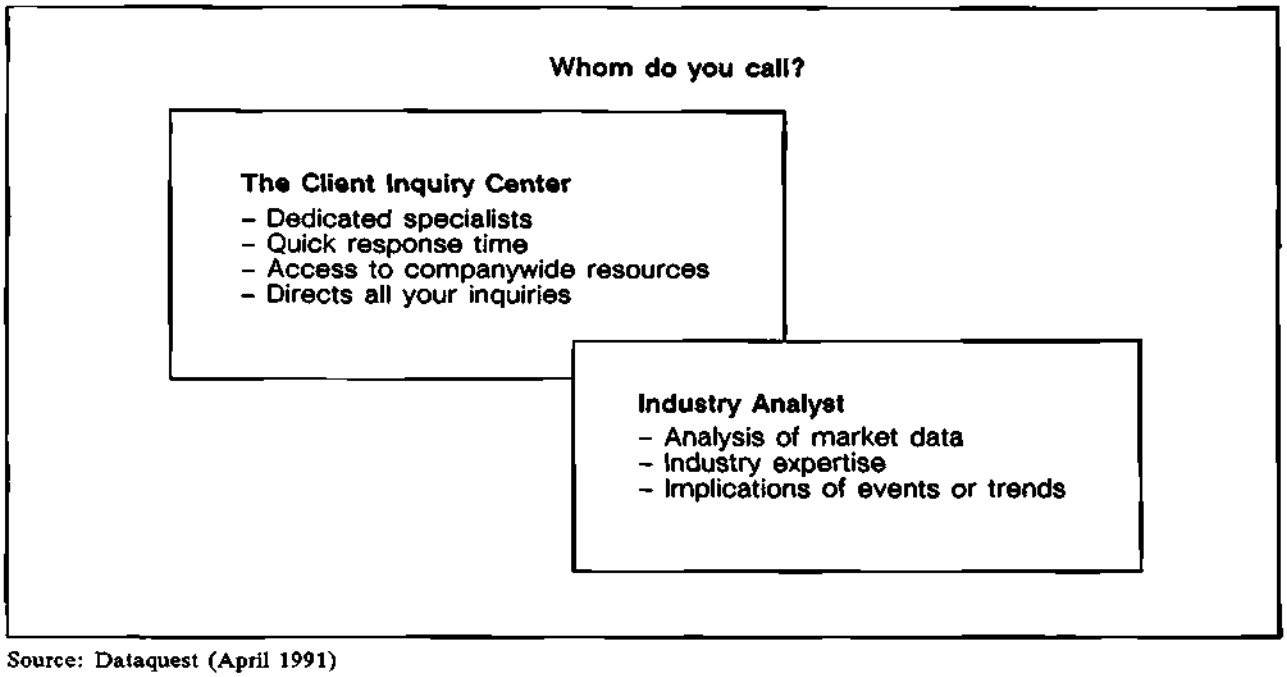
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Figure 2-1
Client Inquiry Center Flow



Source: Dataquest (April 1991)

Figure 2-2
Whom to Call for Your Inquiry



Source: Dataquest (April 1991)

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Information Resource Center

Dataquest's Information Resource Center (IRC) is a valuable supplement to the information delivered through your industry service. It consists of a 1,200-square-foot corporate library in San Jose, plus two major satellite libraries located in Boston and the United Kingdom. The IRC maintains a wide selection of industry directories, trade press periodicals, financial reports from most of the publicly held companies followed by Dataquest industry services, government reports, and CD-ROM-based and on-line information services.

The European Corporate Library maintains more than 300 titles and reference works concerning the European Community, including approximately 30 files and 100 reference works on the 1992 single European market objective. The U.K. library collection includes basic reference works produced by Her Majesty's Government, the Department of Trade and Industry, and other governmental agencies. Special reports have also been collected from a variety of sources, including the U.K. government, trade associations, the Financial Times, and other research organizations.

Appendix A lists the CD-ROMs and computer databases available to clients at the San Jose IRC. The San Jose IRC is staffed by three degreed professionals (Master of Library Science), as well as assistants who specialize in managing the corporation's secondary research resources.

Clients typically use the IRC in the following ways:

- To obtain financial information on the leading companies within their industry
- To collect recent publications on new areas of the market
- To research a market or topic not covered by a Dataquest industry service

You are encouraged to use the IRC. If it is not convenient to visit an IRC, your Client Inquiry Center staff can often make many of the center's resources available to you through your inquiry privilege.

Policies and Procedures

Because the IRC is a private company library, our collections are limited to the following individuals:

- All permanent Dataquest employees
- Current clients—Binderholders and designated alternates from within the client company
- Consultants/contractors working on specific Dataquest projects (only for duration of contract)
- Prospective clients escorted by a Dataquest salesperson

Non-Dataquest Consultants

It is Dataquest policy to deal directly with Dataquest clients in answering their information needs. The Information Resource Center does not authorize the use of library facilities by consultants working for clients.

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Chapter 3

How to Use Your Industry Service

Receiving value from your industry service requires knowing where to find the information you need and how to use that information. The following guidelines will help you get the most out of the many elements of your service.

What Written Materials Will You Receive?

You will receive written material at least twice a month. Some industry services are segmented into key market areas (product or geographic) to allow you to choose the coverage that is most relevant to the markets in which you participate. You will receive written material covering both the broad-based issues of the industry as a whole, as well as the more focused issues of the particular market segment. All written material will be labeled as belonging to one of the following:

- The *Source: Dataquest* binder
- The *Dataquest Perspective* binder
- The segment binder

Source: Dataquest

Source: Dataquest is a regularly updated reference binder in which you'll find the following:

- *How to Use Dataquest:* You are currently in this document.
- *Dataquest High-Technology Guide—Segmentation and Glossary:* This document describes in detail the segmentation and terms used by all Dataquest services to define the markets they track. This guide should be used whenever you are looking for definitions of products, applications, regions, technologies, and environments referred to by your industry service. This document also provides you with standard definitions of research terms that appear in your industry service publications, such as retirements, average selling price, and compound annual growth rate.
- *Dataquest Methodology:* This document will help you understand the research methodology Dataquest uses to gather information on the industries covered by our industry services. It also describes the general assumptions used to generate industry forecasts.
- *Market Statistics:* Each Dataquest industry service provides its clients with documents that contain detailed tables consisting of history, market forecasts, and market share data. We encourage you to use these tables as an opportunity to review your business outlook with Dataquest analysts. Updates and detailed discussions of these data are provided in the *Dataquest Perspective* on an ongoing basis. For segmented services, top-level market statistics are provided in the *Source: Dataquest* binder, and the more detailed statistics for each segment can be found in each segment binder.
- *Company Backgrounders:* You will receive a set of *Company Backgrounders*—profiles on the top players in your industry. These documents are published annually. You should refer to them for corporate overview information, such as financial reports, product line descriptions and analysis, sales and manufacturing locations, and joint ventures, mergers, and acquisitions.

With the exception of the *Company Backgrounders,* these documents will be individually bound and delivered annually or twice yearly, as required. Each *Company Backgrounder* will be updated once a year and will be shipped shortly after the close of the fiscal year for that company. At the time of arrival, the earlier version of the document should be removed from the binder and archived as desired so that the most recent information will be easily accessible to you.

Dataquest Perspectives

Dataquest Perspectives are designed to deliver analysis and Dataquest's view of important issues in your industry. This is a multitopic publication delivered twice a month that contains articles under the following major topic headings:

- Market Analysis: These articles may cover either a product market, regional market, application market, or a distribution channel. Industry service forecast updates are presented and discussed in this section of the *Dataquest Perspective*.
- Product Analysis: These articles analyze the impact of new products on the industry.
- Company Analysis: This section highlights new activities or organizational changes within companies. The articles provide more in-depth analysis of a company's product strategy, financial performance, or marketing performance and strategy than is contained in the *Company Backgrounders*. Articles may also be written about companies for which there is no *Company Backgrounder*.
- Technology Analysis: This section analyzes the impact of key or emerging technologies on your industry. These articles are designed to assist you in strategic and competitive evaluations.
- Conferences and Exhibitions: These articles will identify important industry trends and analyze key events at the conferences and exhibitions attended by Dataquest analysts.
- News and Views: These shorter articles provide Dataquest's perspectives on major industry events.

Dataquest Perspective offers a twice-monthly opportunity to engage your industry service analysts in discussion of the issues and events contained in each publication. For this reason, we provide the name of the author of each article along with a brief synopsis. Clients are encouraged to call the appropriate analyst with questions or a request for more information.

How Do You File Your Written Materials?

Your *Source: Dataquest* binder holds a collection of reference and statistical material. Each document that belongs in this binder will be clearly marked as such and should be filed behind the appropriate tab as indicated in the Table of Contents. Outdated sections should be either discarded or filed separately for archival purposes.

Clients will receive at least 24 *Dataquest Perspectives* each year. These should be filed in the *Dataquest Perspective* binder in chronological order. If you subscribe to a segmented service, at least 4 of your 24 annual *Dataquest Perspectives* will focus on issues specifically related to the markets covered under that industry segment. The industrywide *Dataquest Perspectives* are filed in the core *Dataquest Perspective* binder, and the segment-specific editions are filed in the segment binder.

Each *Dataquest Perspective* will be identified by the name of the service and the name of the segment, if appropriate. It will also have the date, volume, and number on the first page. For example, a subscriber to the Telecommunications—North America service may receive the following two *Dataquest Perspectives:*

- Telecommunications—North America
  Vol. 1, No. 1
- Telecommunications—North America
  Image Communications
  Vol. 1, No. 1

The first document would be filed in the core Telecommunications—North America *Dataquest Perspective* binder. The second would be filed in the Image Communications segment binder.

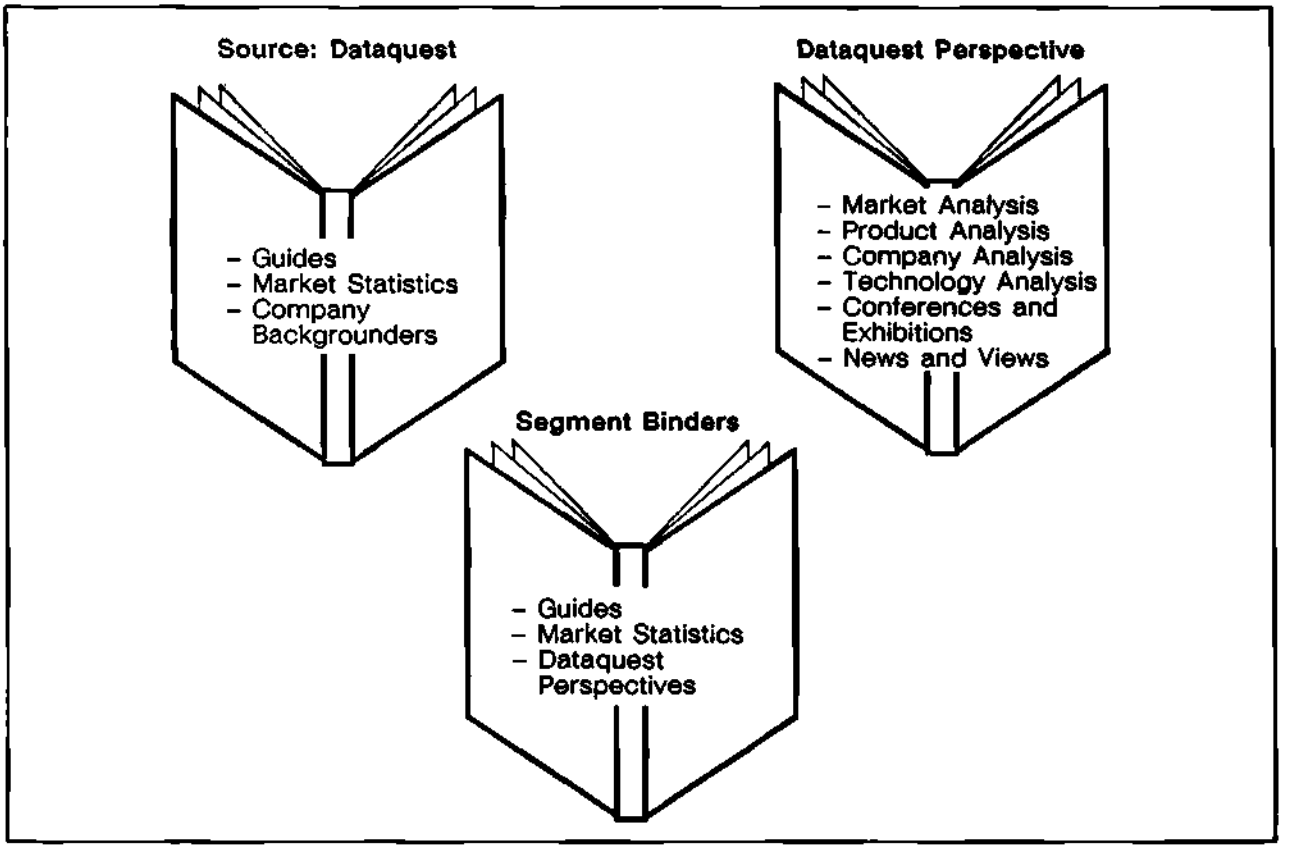
The contents of your binders are illustrated in Figure 3-1. Subscribers to a standalone European country segment will receive detailed market statistics for that particular country, top-level European statistics, and the pan-European Perspectives. The binder contents are illustrated in Figure 3-2.

How Do You Find the Written Material?

Dataquest is committed to not only providing you with the highest quality research, but also

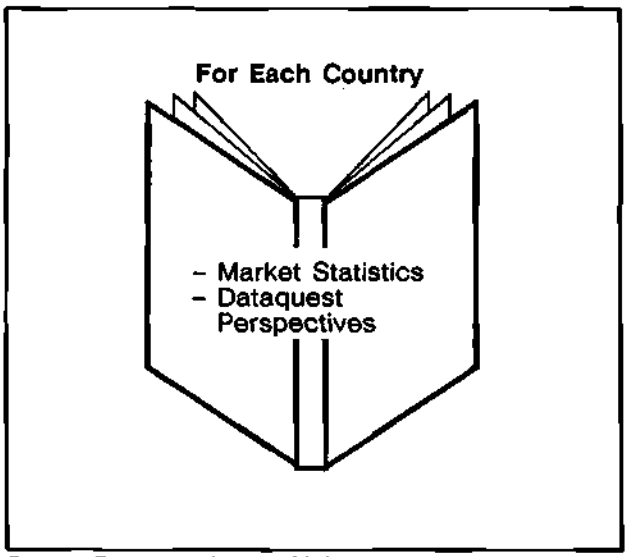
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Figure 3-1
Contents of Your Binder



Source: Dataquest (April 1991)

Figure 3-2
Standalone European Country Binder Contents



Source: Dataquest (April 1991)

making it easy for you to access the information. Clients are provided with the following tools:

- The spines of all binders list the types of information you will find in that binder.
- "What's in This Binder?", appearing immediately following the title page, summarizes the documents in that binder and highlights what can be found in other binders of that service.
- A detailed Table of Contents is contained in the *Source: Dataquest* and segment binders.
- Each bound document in the *Source: Dataquest* and segment binders has its own Table of Contents, including a list of tables where appropriate.
- To help you access the articles you need in a timely manner, Dataquest provides you with a comprehensive index which is delivered quarterly and provides a year-to-date

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cross-reference by company name and major topic. The index lists the titles of all articles and of all tables and figures that appear in issues of the publication. Listings include the title, date, and page number for each entry. The first page of each quarterly index provides an explanation of how the index can best be used, along with an example. Segment Perspectives are indexed separately and incorporated into the year-end index provided for the entire service.

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Chapter 4

Customizing Your Industry Service

As a subscriber to a Dataquest syndicated market research service, clients receive significant tactical and strategic information. Dataquest also offers a variety of individualized and proprietary programs to clients to help them solve their specialized information and analysis needs. Each project is treated with the strictest confidence.

We carefully review each project with the client prior to beginning the actual research. Dataquest's consulting staff designs a research plan that most effectively meets each client's unique requirements. This includes determining the appropriate information to be gathered, the proper sample size, appropriate collection techniques, and the best analytic methods to be used.

Custom Consulting

Dataquest's custom consulting helps clients in any of the following ways:

- Analyzing specific markets and competitive environments
- Developing strategies for increased market penetration
- Evaluating new business, product, and distribution plans
- Verifying critical market assumptions
- Assessing the impact of emerging technologies on existing products and markets
- Assisting in developing international business strategies, including:
  - Identifying strategic partners, both domestic and international
  - Defining technology "fits"

Custom consulting is structured to provide assistance across all TID services beyond the scope of each service. In areas where new, original work is needed, consulting provides value not only through its own individualized proprietary efforts, but also through its integration of TID information and analysis resources.

Among the elements that consulting can bring to a project are specialized planning assistance, proprietary analyses, in-person interviews, mail surveys, telephone surveys, focus groups, and custom database cuts.

Multiclient Studies

Custom Consulting engages not only in full-custom research projects, but also in the generation of multiclient studies. These studies allow Dataquest to offer clients in-depth information on emerging and/or niche markets at an amortized cost for consulting.

Retainer Consulting

Dataquest also offers its clients retainer consulting. Dataquest analysts and consultants provide consulting advice on an ongoing basis and with quick turnaround to address a variety of client management and marketing needs.

Primary Research

Dataquest's Primary Research services offer a comprehensive range of survey research capabilities that can provide vital information tailored to each client's specific needs. This is important when survey work, but not analysis, is needed. Studies of any type, size, or aspect can be performed as a supplement to existing market research efforts, when nonbiased third-party research is required, or to provide complete primary research capabilities when company resources are not available. Primary Research assumes total responsibility for a project at any stage, from questionnaire development through sample selection, data collection, and final tabulation. The following

are examples of the broad range of business applications addressed by Primary Research:

- Market penetration surveys
- Customer needs and satisfaction surveys
- New product research
- Product pricing and positioning surveys
- Annual trend surveys
- Installed base surveys
- Sales trend identification

End-User-Based Services

Score Reports

Customer satisfaction surveys track the level of satisfaction by users of PCs, copiers, electronic printers, PBXs, and public key systems. Key indicators measured include value for price, quality, commitment to customer, features, product delivery, technical documentation, and service. The Score Report is conducted four times a year so that manufacturers can monitor trends in end-user satisfaction levels over an extended period of time.

Score Reports are based on telephone interviews with an annual sample of over 5,000 respondents. A stratified sampling plan is used, with users selected randomly by vendor from a database of U.S. business establishments. No manufacturers' lists are used.

The Score Report survey meets the requirements for measuring customer satisfaction as defined by the Malcolm Baldrige National Quality Award. The Baldrige Award is granted annually by the U.S. Department of Commerce in recognition of U.S. companies that excel in quality achievements and management.

CPE Market Dynamics

This end-user information service provides quarterly data on PBX, Centrex services, and key systems users' purchases by manufacturer, system model, RHC region, state, and vertical market. There are two proprietary custom options, as follows:

- Product-Presence-Hit Rate (PPH) Analysis: Assesses a company's position in the marketplace as a function of product acceptance, distribution, or sales effectiveness.
- Win-Loss Analysis: This option takes PPH analysis one step further, delving into why systems sales are being won or lost by you and your competitors. A customized direct mail, telephone, or personal interview program is established to contact the appropriate end users.

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Chapter 5

Whom Do You Call at Dataquest?

Clients who have questions or need assistance in any way are encouraged to call Dataquest at their earliest convenience. Table 5-1 is an overview of who to contact at Dataquest.

Table 5-1

Who to Contact at Dataquest

Question/Concern	Who to Contact
My subscription (e.g., billing, renewal)	My customer service representative
Subscribing to another service	My sales account manager
Data or facts about my industry	Client Inquiry Center
Opinion or analysis about my industry	Analyst in the service
Other services/products offered by Dataquest	My sales account manager
New services/products I would like Dataquest to offer or feedback on current offerings	Product Marketing Components: (408) 437-8624 Systems: (408) 437-8517 Telecommunications: (408) 437-8602 Peripherals: (408) 437-8308 Ledgeway: (617) 862-8500
An upcoming conference	Conference Department U.S.—(408) 437-8245 Europe—(44) 895-835050 Japan/Asia—(81) 3-5566-0416
A possible proprietary consulting project	Consulting Department, sales account manager, or service analyst
Library visits	Client Inquiry Center, service analyst, or corporate librarian in the U.K.
The new Dataquest format for research delivery	(408) 437-8215, or dedicated Voice Mail Hot Line: (408) 437-7878
Reprints of selected articles	Sales Department—Technology Products: (800) 624-3282

Source: Dataquest (April 1991)

Chapter 6

About Dataquest...

Dataquest was formed in 1971 with the sole purpose of delivering timely and accurate information on critical issues in the high-technology arena. Quoting from the Dataquest mission statement:

> "Our goal is to be the acknowledged worldwide leader in market intelligence for the industries we serve by providing indispensable information and analysis to our clients."

As a member of The Dun & Bradstreet family of companies, Dataquest has access to supplemental information from Dun & Bradstreet and its subsidiaries. Together with our own primary and secondary research capabilities and analyst expertise, this relationship offers the most comprehensive information available on topics pertinent to your industry.

Dataquest comprises two basic business units. Dataquest's Technology Information Division (TID) provides data and analysis on the high-technology electronics industry, encompassing semiconductors, systems, peripherals, application markets, software, and service and support. A cross-industry financial program supported by TID analysts and assigned account managers is tailored to the needs of the financial community. The Machinery Information Division (MID) offers a full range of marketing research and consulting services for professionals in all areas of the heavy equipment and material-handling industries.

The Technology Information Division

The information service you have purchased from Dataquest is part of our Technology Information Division (TID) family of products. TID provides information services that are both tactical and strategic in nature, and include syndicated industry services, custom consulting, multiclient studies, primary research, specialized information services for the financial community, product specification directories, and standalone reports on technology markets. These services are described in more detail in the following paragraphs.

There are five research groups within TID. Each provides data and analysis covering the global electronics industry from semiconductors to systems, from hardware to software, and from applications to service.

Semiconductor Group

This group covers the entire semiconductor "food chain," including manufacturing equipment and materials, device technologies and markets, and end-use applications and procurement issues. Its information services are worldwide in scope and include targeted North American, European, Japanese, and Asian services. The Semiconductor Group is divided into the following 9 services:

- Semiconductors—Worldwide
  - Segments:
    - Semiconductor Memories
    - ASICs
    - Analog and Mixed Signal ICs
    - Microcomponents
    - Gallium Arsenide Semiconductors
- Semiconductors—Europe
- Semiconductors—Japan
- Semiconductors—Asia
- Semiconductor Application Markets—Worldwide
- Semiconductor Application Markets—Europe
- Semiconductor Application Markets—Japan
- Semiconductor Procurement
- Semiconductor Equipment, Manufacturing, and Materials

Systems Group

This group covers business and technical computer systems and applications, both hardware and software, ranging from palmtops to PCs to supercomputers.

Computer Systems Services

The computer systems services cover the following six segments:

- Business Computers
- Servers
- Supercomputers
- Technical Computers
- Unix Systems
- Workstations

European Computer Systems

This service covers the same product areas for 14 European regions.

Microcomputer Systems Group

This worldwide service tracks and analyzes PCs by packaging type, microprocessor, operating system, price point, environment, and region of the world. It includes the following segments:

- Personal Computers—North America
- Personal Computers—Europe
- Personal Computers—Asia
- Personal Computers—European Quarterly Statistics
- Personal Computers—European Price Tracking

Business Applications

This service covers electronic equipment environments in the office that are primarily software driven and looks at the ways in which these environments drive their associated hardware markets. Business Applications is divided into two services:

- Office Software
- Personal Computer Software

Technical Applications

The CAD/CAM/CAE service provides information on four key applications: Mechanical, AEC, GIS/Mapping, and Electronic Design Automation. Its geographic coverage extends to North America, Europe, and Asia. The service is segmented as follows:

- Electronic Design Automation
- Mechanical Applications
- Architecture, Engineering, and Construction, and Geographic Information Systems
- Personal CAD
- CAD/CAM—Europe
- CAD/CAM—Asia

In addition, CASE is covered through consulting.

Telecommunications Group

The Telecommunications Group is divided into two services, the Telecommunications North America service and the Telecommunications Europe service.

These worldwide services divide their coverage of the industry into five major product segments, as follows:

- Image Communications
- Networking
- Personal Communications
- Public Network Equipment and Services
- Voice Communications

Regional market options include country-specific coverage of any of the following European countries: France, Germany, Italy,

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Netherlands, Spain, Sweden, and the United Kingdom.

Peripherals Group

This group covers markets for devices that are typically attached to multiuser host systems or serve an output function.

Computer Storage Service

The Computer Storage service covers the following four segments:

- Rigid Disk Drives
- Tape Drives
- Optical Disk Drives
- Flexible Disk Drives

Graphics and Displays Service

The Graphics and Displays service covers the following four segments:

- Graphics Processors
- Monitors
- Display Terminals
- Network Stations

Document Management Group

The Document Management group is made up of the following four services:

- Copying and Duplicating (including fax coverage)
- Electronic Printers—North America
- Electronic Printers—Europe
- Electronic Publishing

Ledgeway/Dataquest

Ledgeway/Dataquest is the group that provides strategic and tactical information on the fast-growing services industry. Computer systems vendors typically obtain 25 to 30 percent of their revenue from pre- and postsale services. In addition to services provided by manufacturers, there is a very large and fast-growing industry for professional and systems integration services. Ledgeway/Dataquest covers both of these market sectors.

Ledgeway/Dataquest offers 10 different subscription programs. All programs include access to Ledgeway/Dataquest analysts for inquiry support, periodic bulletins on key events in the service industry, and attendance at Ledgeway/Dataquest's annual ServiceTrends conference.

The ServiceTrends Program

The most widely subscribed service, now in its eighth year, is Ledgeway/Dataquest's ServiceTrends program. In addition to the cornerstone of the program, Ledgeway/Dataquest's annual two-volume *Trends and Forecast* report, which provides in-depth market size and forecast information and analysis of market trends, four topical reports are provided. In 1991, these topical reports are:

- *Global Support Strategies*
- *Measuring and Managing Customer Satisfaction*
- *Japan and the Pacific Rim: Customers or Competitors*
- *Self-Service: Opportunity or Threat*

The Professional ServiceTrends program features analysis of customer wants and needs for systems integration and professional services, in addition to a market trends report, which forecasts market size, growth rates, and analyzes trends. In addition, there are six profiles provided on leading participants in the industry.

Sector Market Programs

Sector market programs are focused on narrow segments of the service market and feature an annual market trends and forecast report, user wants and needs analysis, a pricing trends and data study (for all but the European ServiceTrends program), and six profiles of leading service vendors in each sector. Ledgeway/Dataquest's sector market programs are as follows:

- European ServiceTrends
- Independent/Multivendor Services

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- Network/Communications Support
- Mini/Mainframe Software Support
- PC/Workstation Software Support
- Technical Workstation Service and Support
- PC/End-User Computing Services
- Channel Support Strategies

In addition to its subscription services, Ledgeway/Dataquest has a very professional and active custom consulting group that conducts custom projects focused on the following areas:

- Customer satisfaction and service quality audits
- Key competitor analysis and positioning
- New service product market analysis and strategy formation

Subscription services and custom consulting are provided covering worldwide markets.

The Executive and Financial Group

Dataquest's Executive and Financial Group (EFG) offers a number of cross-industry services that are designed primarily for clients in the financial and executive communities. These services offer clients the following benefits:

- Access to all Dataquest research professionals
- Access to TID *Dataquest Perspectives*
- Access to TID conferences
- A personal account manager

EFG includes the following services, which are differentiated largely in terms of the type of clients they serve.

Financial Services Program

The Financial Services Program (FSP) is designed to serve the needs of clients who evaluate loans and investments, monitor portfolios, identify markets and prospects, and develop strategies for penetration of new markets. FSP clients include banks, venture capital firms, CPAs, leasing companies, and development agencies. The program benefits these clients by helping them develop financial strategies in high-technology areas, identify financial opportunities, evaluate proposed client investments and relationships, and monitor companies and markets.

Strategic Executive Service

The Strategic Executive Service (SES) is a networking and technology advisory program specifically designed for CEOs or senior executives. The service is open by invitation only to the presidents of technology companies. Dataquest senior staff from all high-technology industry service groups provide decision support to each president. SES also hosts an annual Presidents' Summit Conference, bringing together subscribers to focus on future trends in high technology products and markets. It is a highly customized service for executive decision makers.

Equipment Leasing Service

At the core of Equipment Leasing Service (ELS) is a portfolio of more than 300 individual future value projections for specific products from more than 45 leading computer, peripherals, and telecommunications vendors. These projections are calculated through a proprietary model and are delivered to clients along with relevant research newsletters. Clients also receive inquiry access to specialized leasing analysts. ELS is designed for companies that lease high-technology equipment. The service assists clients in the areas of lease origination sales, vendor sales, equity sales, asset management and remarketing, and new business development and marketing.

Technology Investment Program

The Technology Investment Program (TIP) is designed to serve the needs of clients in the securities industry, investment banking industry, equity research markets, and institutional investment fields. The service provides clients with company evaluations, product and technology assessments, and other forms of information that help identify target companies for merger/acquisition, joint venture, initial public offerings, and equity investment.

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Other Dataquest Services

Conferences

Technology Information Division Conferences

Dataquest hosts a number of conferences each year to present industry forecasts and discuss critical issues and trends. Clients obtain a number of benefits from attending these conferences, including:

- Receiving Dataquest updates on key markets
- Meeting with industry leaders and users
- Discussing market events and their significance to your organization with Dataquest analysts

As an industry service client, you may purchase tickets to any Dataquest conference you wish to attend. Each ticket entitles you, or someone you designate, to attend one Dataquest conference. A complete list of conferences is included in Appendix B of this document. To purchase a conference ticket, or to obtain more information about Dataquest's conferences, contact Dataquest's conference department at any of the following locations:

- North America
  (408) 437-8245
- Europe
  (44) 895-835050
- Japan/Asia
  (81) 3-5566-0416

Invitational Computer Conferences

Dataquest's Invitational Computer Conferences (ICCs) bring major computer manufacturers together with buyers in 41 regional markets around the world. The one-day ICC format combines hands-on product displays with technology seminars designed to educate prequalified regional buyers throughout the United States, Europe, and Asia/Pacific. Each SalesEvent ensures a focused conference, whereby the manufacturers have a selectively targeted audience of buyers and the buyers can learn about new technology, receive a hands-on view of products and solutions, and discuss their application needs with exhibiting regional sales and technical managers. Three ICC series are held as follows:

- *OEM Peripherals* (in various U.S. and European locations), serving OEMs, systems integrators, volume end users, and government buyers/integrators who are all looking to buy computer peripherals.
- *Computer Connectivity* (in various U.S. and European locations), serving MIS/DP managers, systems integrators, network managers, and value-added resellers/dealers who are all looking to buy connectivity/networking solutions.
- *Asia Pacific* (in various Asian locations), serving OEMs, systems integrators, volume end users, and government purchasers who are all looking to buy computer peripherals.

Technology Products

Dataquest also provides standalone products, including specification guides in both hard copy and electronic format (disk), reports, and monthly newsletters that are marketed and sold individually to broad customer audiences. These products are designed to be complementary to the TID syndicated market research services and include highly tactical information on product specifications and pricing, as well as in-depth analyses of specific markets and technology trends. See Appendix C for a current list of products.

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Chapter 7

Subscription Terms

Basic Terms of Syndicated Industry Services

The service begins on the date of the first billing. At that time, the subscriber receives the *Source: Dataquest* binder with the current documents and a *Dataquest Perspectives* binder complete with documents covering the last six months. Clients also receive the current year-to-date index as well as the previous year's annual index.

Subscribers to a segment of a service receive a segment binder containing recent segment-specific *Dataquest Perspectives* and the current version of the detailed, segment-specific market statistics. For the duration of the subscription, subscribers receive a copy of each *Dataquest Perspective* published and any annual updates to *Source: Dataquest* documents as they are produced. The inquiry privilege may be used to supplement the material in the binders.

Add-On Subscriptions

Subsidiaries, divisions, regional offices, majority-owned affiliates, and parent companies of a subscribing organization within the same region are eligible for add-on subscriptions at a percentage of the base subscription price. Add-on subscriptions include complete copies of all published material, inquiry privileges specific to the markets subscribed to, and conference attendance at discounted prices. Regions are defined as North America, Europe, and Japan.

Payment Terms

Dataquest's terms, including the applicable sales or value-added tax, are net 30 days.

Base Price

Dataquest reserves the right to change its subscription prices to reflect broadened scope or increased costs. Subscribers will be notified in advance of any such price increase.

A Reminder

Your agreement specifies the individuals in your company who have access to Dataquest information. You will need to obtain written consent from Dataquest to disclose data, analysis, and written materials to any other person or entity beyond those specified by the terms of the agreement.

Dataquest also asks that you not use any data obtained through your industry service in any legal proceedings, or as the basis for advertising copy, press releases, collateral material, or any other promotional material. For further information on the conditions pertaining to your industry service, please refer to your industry service agreement, or contact your sales representative.

Your industry service agreement provides you with a license to use your industry service for the length of time designated in the agreement. If you decide not to renew your industry service at the end of this time, it is your obligation to return these materials to your nearest local Dataquest office.

We Thank You for Choosing Dataquest as Your Marketing Research Partner.

We hope this guide has helped you. Please take advantage of the services we have described. Dataquest's goal is total satisfaction. If you have any questions or comments about this guide or the services it describes, please let us know.

Appendix A

Dataquest Information Resource Center CD-ROMS and Computer Databases

PATENTS

Micropatent

This CD-ROM is a basic search and current awareness tool for U.S. patents, containing abstracts and selected front-page information from patents published by the U.S. Patent and Trademark Office. It covers 1975 to date, with limited information 1969 to 1974. Patent number, inventor, title, and assignee are just a few of the ways to search this CD. It is updated monthly. Book version not available.

FINANCIAL INFORMATION

Compact d Sec—USA

This CD-ROM contains financial and management information on 11,000 public companies filing with the SEC. The current and historical financial information is culled from annual reports and 10-Ks. It is updated monthly. Book version not available; however, the library files have annual reports, 10-Ks, quarterly reports, and 10-Qs. Please check the lateral files and the listing on top of the files.

Compact d Sec—Canada

This CD-ROM provides financial information on 6,000 Canadian companies and is updated quarterly. Book version not available; however, the library files have annual reports. Please check the lateral files and the listing on top of the files.

Compact d Sec—Europe

This CD-ROM provides financial and factual information on 2,000 publicly held European companies and is updated quarterly. Book version not available; however, the library files have annual reports. Please check the lateral files and the listing on top of the files.

COMPANY DIRECTORIES

Corptech

This database contains information on developers and manufacturers of high-technology products in the United States. It is searchable by product, location, size, status, and name and is updated quarterly. Book version available.

Thomas Register

This CD-ROM provides product and directory information for manufacturing companies in the United States and Canada. It is updated monthly. Book version available.

ARTICLE SEARCH

Computer Select (formerly Computer Library)

This CD-ROM is a major upgrade to Computer Library. In addition to the ever-growing list of periodicals included in Computer Select, the full contents of Data Sources, the most comprehensive computer industry directory available, have been added. You'll be able to retrieve specifications on over 67,000 hardware, software, and data communications products, as well as profiles of the over 1,000 companies that make them. New searching capabilities include locating articles by choosing lists of publications, article types, date ranges, topics, and other fields. It is updated monthly. Book version of Data Sources available.

COMPUTER DIRECTORIES

ICP Software Information Database

This CD-ROM provides information on micro, mini, and mainframe software products offered by over 4,000 vendors and is updated quarterly. Book version available.

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Appendix B

Dataquest 1991 Conference Schedule

North America		
Forecast '91-Technology Briefing	March 5	San Jose
Ledgeway Service & Support	April 8-9	San Francisco
Semicon/West	May 22	Redwood City
Document Management	June 27-28	San Francisco
Personal & Wireless Communications	August 12-13	Monterey
Portable Computing	September 11-12	San Jose
Semiconductor	October 14-16	Monterey
Europe		
Computer Industry	February 14-15	London
	February 19-20	Milano
	February 25-26	Frankfurt
	March 6-7	Paris
Semicon/Europa '91	March 6	Zurich
Semiconductor	May 29-31	Marbella
Printer	June 11-12	Amsterdam
Colour Market	June 12-13	Amsterdam
Copying & Duplicating	June 13-14	Amsterdam
Telecommunications	November 7-8	London
Japan and Asia		
Semiconductor	April 22-23	Tokyo
Computer & Telecommunications	June 25-26	Tokyo
Strategic Industry	September 24-25	Taipei
Peripherals	October 1-3	Tokyo

For reservations or further information call: U.K. 895-835050 San Jose (408) 437-8245 Tokyo 3-5566-0411
January 1991—Subject to revision

Appendix C

Technology Products

SpecCheck Guides

Copier SpecCheck-On-Disk Disk version of the Copier SpecCheck Guide. Allows custom sorts on 500 models and 24 vendors. Six annual updates on either 3.5-inch or 5.25-inch format.

Copier SpecCheck Guide Detailed specifications and pricing information on 500 copier models. Two full books, two updates per year.

Fax SpecCheck-On-Disk Disk version of Fax SpecCheck Guide. Allows custom sorts on 600 models and 47 vendors. Six annual updates on either 3.5-inch or 5.25-inch format.

Fax SpecCheck Guide Detailed specifications and pricing information on 600 fax models. Two full books, two updates per year.

PC SpecCheck-On-Disk Disk version of PC SpecCheck Guide. Allows custom sorts on 400 models and 47 vendors. Six annual updates on either 3.5-inch or 5.25-inch format.

PC SpecCheck Guide Detailed specifications and pricing information on 400 PC models. Four full books per year.

Personal Page Printer SpecCheck-On-Disk Disk version of Personal Page Printer SpecCheck Guide. Allows custom sorts on 400 models and 100 vendors. Four annual updates on either 3.5-inch or 5.25-inch format.

Personal Page and Ink Jet Printers SpecCheck Guide Detailed specifications and pricing information on 275 personal page and ink jet printer models. Two full books per year.

Dot Matrix Printer SpecCheck Guide Detailed specifications and pricing information on 300 dot matrix printers. Two full books per year.

High-Speed Page and Line Printers SpecCheck Guide Detailed specifications and pricing on 300 high-speed page and line printers. Two full books per year.

Reports

Imaging Materials Series

Series of reports on key areas of the imaging materials industry. Reports currently available or planned are:

Toner in the '90s: The Shape of Things to Come Detailed analysis of the liquid and dry toner and developer industry. The report looks at market size, structure and growth, U.S. and foreign producers, and trends in materials manufacturing and distribution. Includes directory of suppliers. Available now.

Specialty Papers and Films: New Technology, Media, and Markets In-depth report on the hard-copy media field for paper and film products. The report looks at imaging processes, imaging hardware, end-use applications for hard-copy output, and market size and forecast. Includes directory of suppliers. Available June 1991.

The Photoreceptor Industry: A Marketing and Technical Analysis Detailed analysis of photoreceptor technology and the industry. Volume I chronicles the evolution of the industry in terms of equipment, manufacturing, and distribution, providing market size and forecasts. Volume II is a complete reproduction of U.S. patent abstracts from 1979-1990. Includes directory of manufacturers. Available Fall 1991.

Other Reports

Fax On Demand—Marketing Tool for the '90s A useful report to help end users evaluate and select voice/fax systems and implement fax-on-demand services for their business. Includes applications, technology, and economic considerations for fax-on-demand, as well as a directory of product vendors and service providers. Available June 1991.

Color Scanner User Survey for U.S. Publishing Markets Extensive survey of key end-user

markets in publishing, advertising, printing services, graphic design, PostScript output services, and Fortune 1000 companies to ascertain purchase intentions and installed base of color and monochrome scanners. Available May 1991.

Semiconductor Industry Insights—from Silicon to Systems Analysis of the global semiconductor industry containing market forecasts, key drivers, product demand, semiconductor production, equipment, and materials.

Voice Processing Opportunities in the U.S.—A Market Assessment and End-User Survey Extensive end-user survey providing networking information, applications, satisfaction level, purchase decision making, and selection criteria by key vertical markets. Also includes market shares, technology, standardization, revenue, and pricing forecasts through 1994.

High-Speed Printing Applications in Banking A vertical market study comprising two reports and videotapes/transcripts of three focus sessions. Study focuses on high-speed printing applications in the banking industry and examines the applications that banks print internally and externally, as well as special printing capability needs of the banking industry.

Portable Computing in the 1990s Three-part series on the latest products, features, and options for transportables, laptops, notebooks, palmtops, and electronic daybooks.

PC LAN Markets in Europe 1990 Analysis of all the major PC LAN vendors in 13 European countries. Market shares, forecasts, distribution channels, and shipments segmented by end-user types.

Computer Usage in European Banks 1990 In-depth, two-volume study on the demand for hardware, applications, LANs, and operating systems in European banks, segmented by bank size. A widespread survey of banks in nine European countries was supplemented by personal interviews with key decision makers at the largest banks.

Monthly Newsletters

Copier FAXts A look at new products, distribution, organizational news, and trade show highlights for the copier and fax industries.

IC Europe All the latest local intelligence and analysis of new products, alliances, technology impacts, and forecasts for the European semiconductor industry.

European Monitor Monthly newsletter with all the latest news on vendor, product, and distribution developments in the European personal computer market.

Price Tracking Flash Monthly newsletter on PC product announcements and changes in price, configuration, and distribution for PC products by 16 manufacturers in 14 European countries.

Other Technology Products

Company Backgrounders by Dataquest Detailed vendor profiles on almost 300 leading worldwide high-technology companies highlighting company strategic direction, business direction, detailed product line summaries, information on joint ventures, mergers and acquisitions, and licensing agreements.

DQ Monday On-Line News, analysis, and current prices for 25 leading semiconductor product groups for all the major markets: United States, Europe, Japan, Hong Kong, Taiwan, and Korea.

DQ Test Target Package of ten 8.5 x 11-inch copier/fax test patterns: gray scale, black and white, and color.

International Test Target Package of ten standard European-size test targets.

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Dataquest Research Methodology

Source:
Dataquest

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Dataquest Research Methodology

Source: Dataquest

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Published by Dataquest Incorporated

The content of this report represents our interpretation and analysis of information generally available to the public or released by knowledgeable individuals in the subject industry, but is not guaranteed as to accuracy or completeness. It does not contain material provided to us in confidence by our clients.

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March 1991

Dataquest's Research Philosophy—Methodology for Value

From semiconductors to systems, office to factory automation, Dataquest provides quality research on more than 25 separate high-technology industries and their markets.

Fundamental to the way Dataquest conducts its research is an underlying philosophy that says the best data and analysis come from a well-balanced program. Such a program includes a balance between primary and secondary data collection techniques; between supply-side and demand-side analysis; between focused, industry-specific research and coordinated, "big picture" analysis; and between the informed, insightful perspectives of experienced industry professionals and the rigorous, disciplined techniques of seasoned market researchers. Ultimately, this leads to a balance between data and analysis—the combination of which provides unique insight and ultimate value to our clients.

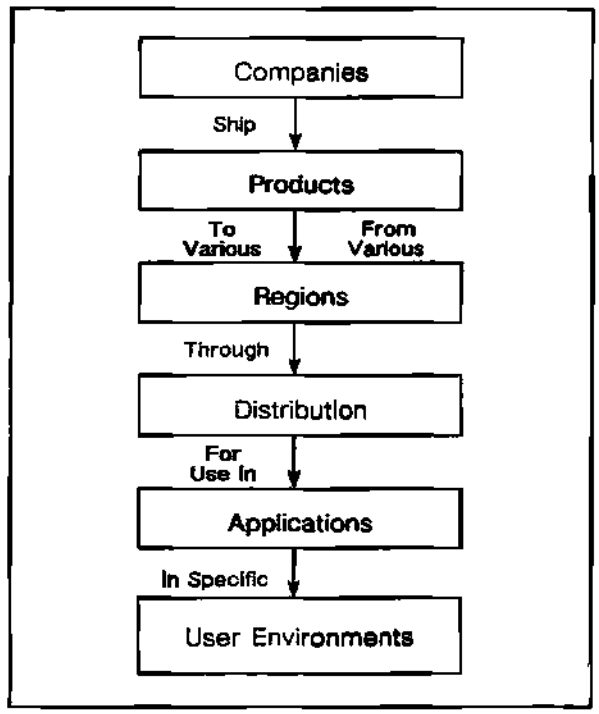
Market Segmentation—Setting the Standards

The design of market segmentation and data standards is a critical issue at Dataquest. Much effort is devoted to choosing and defining the way products, industries, and markets are segmented. Dataquest's objective is to provide data and analysis along lines of segmentation that are logical, appropriate to the industry in question, and immediately useful to clients.

Over the years, Dataquest has consistently established industry-accepted standard segmentations for the way we follow products and their movement. Figure 1 reflects the way we track products. Further, we spend a great deal of time and effort in defining *how* we track these products and determining what *our* definitions are for the market metrics we use—for example, shipments, installed base, retirements, factory revenue versus end-user revenue, market share, and so on.

We follow several dimensions. Sometimes there are one-to-one, or dedicated, relationships between dimensions—for example, between software products and their applications. We believe that all major high-technology industries mirror this scheme. Note that we do not use the term vertical markets. This term is often used to refer to either applications or environments because both terms describe the use of a product. Application describes what the product is used for, and environment describes where the product is used. The term vertical market often is used for either of these terms and thereby can cause confusion.

Figure 1
How Dataquest Tracks High Technology



Source: Dataquest (March 1991)

We have therefore standardized on the following terminology, which distinguishes between application and environment, for each dimension we follow:

- Major product categories:
  - Materials
  - Components
  - Boards and subsystems
  - Equipment
  - Software
  - Consumables
  - Services
  - Others
- Product—A good or service
- Product category—A group of similar products
- Region—Geographic areas of both shipments and consumption
- Distribution—The path by which a product moves from manufacturer to ultimate user
- Application—The use to which a product is put; the function it performs
- Environment—Where a product is ultimately used

The Dataquest Staff

Dataquest believes that in order for an analyst to understand and analyze an industry, the analyst must have competed in it. To that end, our staff is heavily populated with professionals who have extensive experience in the industries they analyze. These analysts have held high-level positions in engineering, marketing, product development, and other related areas.

These industry veterans are complemented by a staff of professional market researchers who understand the principles of market research and who direct Dataquest's programs in primary and secondary research, demographics, economics research, statistical analysis, forecasting, and modeling. Figure 2 illustrates our staffing philosophy. This blend of experience and training is unique in the research industry and allows Dataquest to provide its clients with market research of unequaled value.

To develop industry analysis and data, Dataquest collects a wide spectrum of information from a carefully selected portfolio of sources. Data are collected directly by our researchers in the United States, Europe, Japan, and Asia.

Primary Research

The principal data collection methodology at Dataquest is primary research—firsthand data collection by Dataquest researchers. Primary research is conducted with businesses, households, government, and schools; manufacturers, suppliers, and distributors; and product end users. Dataquest's in-house Primary Research Group (located in San Jose and Paris) processes more than 10,000 interviews each month, through both mail and telephone interviews, as well as using focus groups and personal interviews. Questionnaires are developed by the Primary Research Group in conjunction with Dataquest industry analysts.

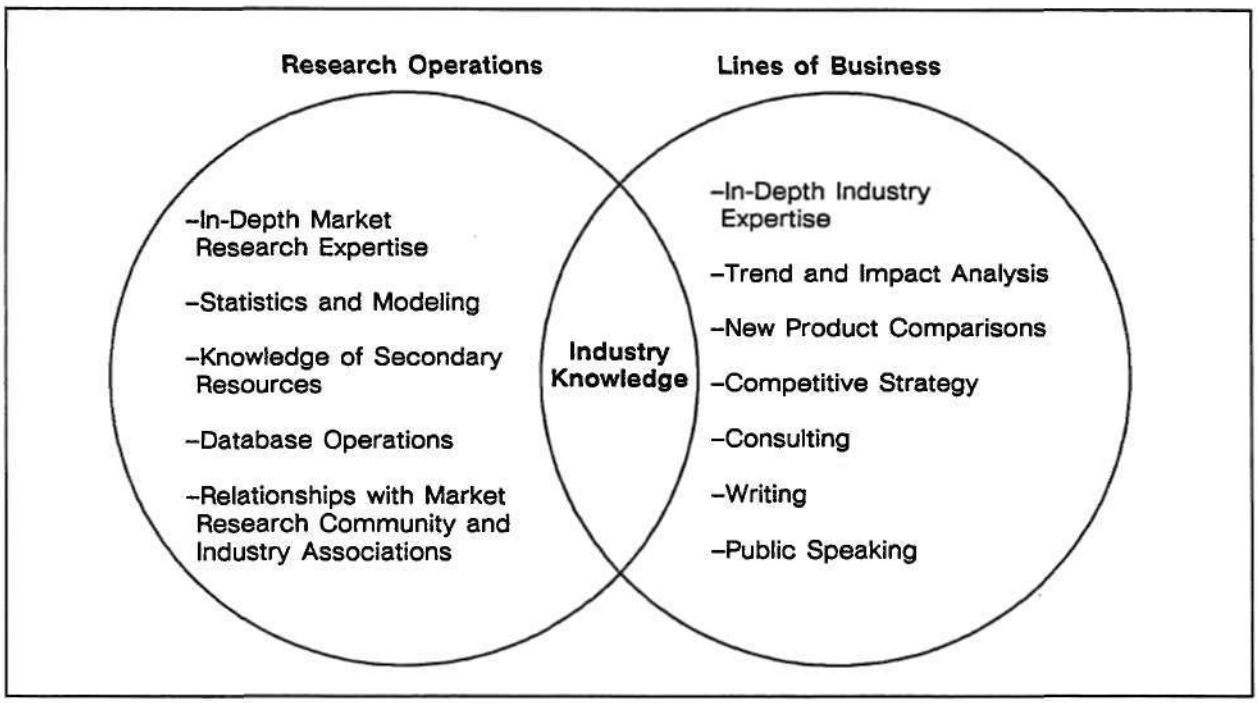
All surveys have been designed and demographic samples selected to answer specific inquiries. These samples conform with Dataquest's standard demographic profiles so that results will comply with existing data structures.

The samples are drawn from a variety of sources, frequently from the databases of our parent company, The Dun & Bradstreet Corporation, including the Dun's Market Identifier File of 6 million U.S. businesses. We also draw samples from the databases of Computer Intelligence and Focus Research. The number of interviews conducted is usually specified to produce data with a reliability of ± 5 percent at a 95 percent confidence level.

Following questionnaire development and sample selection, each survey undergoes a rigorous pretesting to make sure the interview captures the desired information. Once adjustments have been made, the telephone surveys are conducted on-line by Dataquest's in-house team of professional interviewers. Call monitoring allows us to provide quality control throughout the process. All data entry and tabulation are done in-house.

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Figure 2
Research Organization



Source: Dataquest (March 1991)

Firsthand Observation

On a daily basis, Dataquest watches and measures high technology around the world, using yet another technique of primary research: firsthand observation. Dataquest analysts regularly visit the laboratories, R&D facilities, and manufacturing plants of the companies they follow. They view the technologies and new products; study the manufacturing yields and levels of automation; and meet the people behind the products and companies, from start-up companies to industry leaders.

Secondary Sources

Primary research is supplemented with a review of secondary-source materials. Dataquest's Information Resource Centers throughout the world maintain an extensive collection of information including technical, trade, and general business periodicals; reports; economic data; technical papers; patents; government data; directories; financial literature; product literature; press releases; and many on-line databases. These sources provide specific data points and qualitative input to Dataquest analysis. They cover trends in technology, pricing, manufacturing capacity, competition, product features, demand, buyer behavior, and macroenvironmental forces such as demographics, the economy, and the regulatory arena. The following steps reflect the overall research process at Dataquest:

- Initiate and clarify research request
- Develop methodological approach
- Develop questionnaire
- Select sample
- Load questionnaire (on-line interviewing)
- Prepare estimates (if appropriate)
- Conduct interviewer briefing
- Pretest
- Interview

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- Perform quality check and call monitoring
- Merge data
- Perform scrubbing, tabulation, and statistical analysis
- Approve data
- Report on and deliver results
- Maintain database (as required)

The following is a typical cadre of sources:

- Industry contacts
- Industry associations and user groups
- Trade shows and conferences
- Demographics
- D&B economic research
- D&B credit services
- Computer intelligence
- Document management systems
- Focus Research
- Government and regulatory agencies
- Industry and trade publications
- Public databases and libraries
- Annual reports and Forms 10-K
- Product specifications and press releases
- Patent activity

Market Sizing and Market Share

Dataquest conducts surveys of manufacturers and distributors in their respective industries monthly, quarterly, or annually. These surveys collect information on shipment and inventory levels, pricing, and short-term market expectations. Data are checked and cross-checked across data collection points at the supplier, manufacturer, distributor, and end-user levels.

This data collection effort resides at the core of our standard syndicated industry services. We use demand-based surveys for many of our newer products and custom consulting. However, the balance of this discussion focuses on our standard, syndicated industry service product line.

We first develop a company universe for each industry. The sources reflected in Figure 2 are checked to make sure that we have a full census of industry participants.

Next, Dataquest analysts and researchers derive estimates for each product or product category for which we collect shipment and revenue data. The estimates are then provided to vendor representatives for correction or substantiation.

The data collected in our vendor surveys are always considered public information. The data are used to allow bottom-up analysis defining market revenue, market size, and market share. The names of respondents are always kept confidential, and all data are published as Dataquest estimates. All respondents are notified of our policies when our market estimates are initially sent.

Following is a list of steps we go through to derive estimates and reconcile the responses for final approval and reporting:

- We establish product category or model-level detail.
- We establish estimates and check against the following:
  - Aggregate data
  - Industry forecast
  - Historical performance
  - Growth rate of competition
  - Growth rate of related products
- We use the following sources:
  - Vendor verification
  - Quarterly financials
  - Industry associations
  - Distribution channel data
  - Manufacturing capacity
  - Life-cycle analysis
  - Components and peripherals purchases
  - Consumables production
  - Ongoing dialog with industry sources

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  - Industry analysts' qualitative insight
  - Government statistics
  - Other secondary sources
- We reconcile responses against Dataquest segmentation standards.

Market Forecasts

We believe that complex interrelationships among the various products, markets, and high-technology industries that we follow should be understood and accounted for in the assumptions underlying each forecast. Forecasts must reconcile the complementary nature of systems, peripherals, and components.

Our forecast methodology begins with the completion of our vendor-based data acquisition, which is used to establish market size for the given year of data collection. These data are used to measure the accuracy of our previous year's projection for the current year. This infrastructure creates a critical foundation that is the starting point for our forecasts.

No single forecast model applies at Dataquest because of the large scope of products and industries that we follow. We have a basic forecasting framework in place that incorporates both quantitative and qualitative data to derive forecasts. Analysts take the following factors into consideration when deriving and cross-checking forecasts and their assumptions:

- Macroeconomics
- Emerging technologies
- Life-cycle analysis
- Retirements
- Environmental trends
- Demographic trends
- Product availability
- Buying intentions
- Captive production
- Historical growth
- Historical pricing
- Installed base
- Saturation
- Obsolescence
- Import and export
- Most likely constraints
- Total available market

Finally, we regularly hold research forums that provide an open exchange of opinions for our analysts.

Throughout Dataquest, each variable must be defined and measured in the same way. Analysts may vary the relationships between variables but not the values themselves. Not all variable relationships hold true for all industries; therefore, analysts may specify which sets of variables to use. Data must be reported according to Dataquest standard segmentation, and all final data must be approved before they are reported. *All* preliminary data are clearly stated as such. All final data are reported as Dataquest estimates. Our information is sourced appropriately with the phrase "Source: Dataquest," and the data are stamped with a date so that users have a clear understanding of what iteration they are using and the assumptions behind those data.

Dataquest Market Research—What's behind the Numbers?

When Dataquest clients receive forecast data with the familiar line "Source: Dataquest," they receive the end result of a rigorous process of primary and secondary data collection; supply-side, demand-side, and macroenvironmental analysis; and the cross-industry perspective afforded by Dataquest's uniquely broad and in-depth worldwide coverage of high technology.

Behind the numbers is a thorough discussion, involving industry professionals and research experts, and testing of the assumptions used to develop Dataquest's forecasts. In this way, clients get more than simply a single point of data for planning and decision making. Behind the numbers is a commitment to quality—a worldwide organization of people committed to supplying the highest-quality *information* and *analysis* to Dataquest's clients.

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Dataquest High-Technology Guide

Segmentation and Glossary

1991

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Dataquest High-Technology Guide

Segmentation and Glossary

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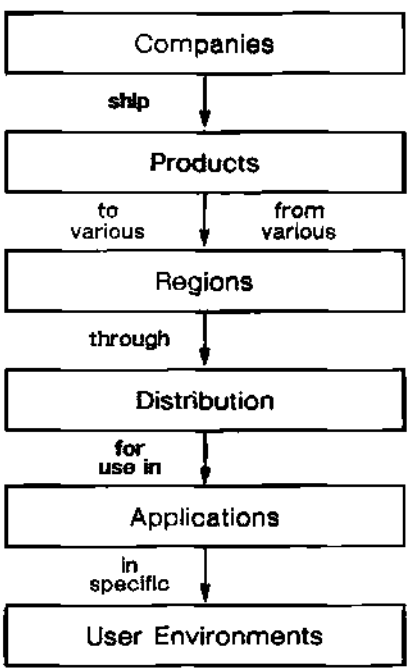
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High–Technology Guide

The *High–Technology Guide* provides a reference for Dataquest research, analysis, and publications. The segments and terms found in this guide are used consistently in our research and methodology and throughout Dataquest products.

The *High–Technology Guide* is divided into two parts: segmentation and glossary. The segmentation section provides a comprehensive listing of the classifications used in our research. This segmentation is broken into different dimensions including companies, products, regions, distribution, applications, and user environments. These dimensions are illustrated below (see Figure 1). The glossary is an alphabetical list defining the terms found in the segmentation section.

Figure 1
Research Dimensions



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Segmentation

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Companies

The companies section contains more than 3,500 companies on which Dataquest conducts research. These companies are studied because of their concentration or emphasis in technology markets and industries. The company segmentation shows the breadth and depth of collective coverage that Dataquest maintains. Because of the extensive nature of the company list, it is not published in this guide but can be provided upon request.

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Products

The products section lists high-technology products. This section presents the segmentation of the technology as defined by Dataquest.

The major categories of products are as follows:

- Materials
- Components
- Boards and Subsystems
- Equipment
- Software
- Consumables
- Services
- Other Products

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Products

MATERIALS

- Wafer
  - Silicon Wafer
  - Epitaxial Wafer
- Gas
  - Bulk Gas
    - Nitrogen
    - Oxygen
    - Hydrogen
    - Argon
  - Specialty Gas
    - Silicon Precursor
    - Dopant
    - Plasma Etchant
    - Reactant Gas
    - Atmospheric/Purge Cylinder Gas and Other
  - Plastics

COMPONENTS

- Semiconductor
  - Integrated Circuit
    - Bipolar Digital (by Technology)
      - TTL/Others
      - ECL
    - Bipolar Digital (by Function)
      - Bipolar Digital Memory
        - Bipolar RAM
        - Bipolar Nonvolatile Memory
        - Other Bipolar Memory
      - Bipolar Digital Microcomponents
      - Bipolar Digital Logic
        - Bipolar ASIC
          - Bipolar Gate Array
          - Bipolar PLD
            - Bipolar PLA
            - Bipolar PMD
            - Bipolar FPGA

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COMPONENTS

- Bipolar ASIC (Continued)
  - Bipolar Cell-Based IC
- Bipolar Custom IC
- Bipolar Standard Logic
- Other Bipolar Logic

MOS Digital (by Technology)
- NMOS/PMOS
- CMOS
- BiCMOS

MOS Digital (by Function)
- MOS Memory
  - DRAM
    - 16K DRAM
    - 32K DRAM
    - 64K DRAM
    - 128K DRAM
    - 256K DRAM
    - 1Mb DRAM
    - 4Mb DRAM
    - 16Mb DRAM
  - SRAM
    - Slow SRAM
      - 1K SRAM
      - 4K SRAM
      - 8K SRAM
      - 16K SRAM
      - 64K SRAM
      - 256K SRAM
      - 1Mb SRAM
      - 4Mb SRAM
    - Fast SRAM
      - 1K SRAM
      - 4K SRAM
      - 8K SRAM
      - 16K SRAM
      - 64K SRAM
      - 256K SRAM
      - 1Mb SRAM
      - 4Mb SRAM

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COMPONENTS

- Nonvolatile Memory IC
  - ROM
    - 4K ROM
    - 8K ROM
    - 16K ROM
    - 32K ROM
    - 64K ROM
    - 128K ROM
    - 256K ROM
    - 1Mb ROM
    - 2Mb ROM
    - 4Mb ROM
    - 8Mb ROM
    - 16Mb ROM
  - EPROM
    - 16K EPROM
    - 32K EPROM
    - 64K EPROM
    - 128K EPROM
    - 256K EPROM
    - 1Mb EPROM
    - 2Mb EPROM
    - 4Mb EPROM
    - 8Mb EPROM
  - EEPROM
    - 1K EEPROM
    - 2K EEPROM
    - 4K EEPROM
    - 8K EEPROM
    - 16K EEPROM
    - 32K EEPROM
    - 64K EEPROM
    - 128K EEPROM
    - 256K EEPROM
    - 512K EEPROM
    - 1Mb EEPROM
  - Other MOS Memory
- MOS Microcomponents
  - MOS Microprocessor (by Word Length)
    - 8-bit MOS MPU

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COMPONENTS

- MOS Microprocessor (by Word Length) (Continued)
  - 16-bit MOS MPU
  - 16/32-bit MOS MPU
  - 32-bit MOS MPU
  - 32/64-bit MOS MPU
  - 64-bit MOS MPU
- MOS Microprocessor (by Technology)
  - CISC MOS MPU
  - RISC MOS MPU
- MOS Microcontroller
  - 4-bit MOS MCU
  - 8-bit MOS MCU
  - 16-bit MOS MCU
  - 32-bit MOS MCU
  - Digital Signal Processor
    - DSP Microprocessor (DSMPU)
    - Microprogrammable DSP (MPDSP)
    - Special-Function DSP (SFDSP)
- MOS Microperipheral
  - System Support Peripheral
    - Traditional Peripheral
      - Counter/Timer
      - DMA
      - Interrupt Controller
      - Memory Management
      - Real-Time Clock
      - Others
    - General-Purpose I/O
    - DRAM Controller
    - Cache Controller
    - PC Logic Chip Set
  - Display Peripheral
    - Alphanumeric CRT Controller
    - Graphics Controller
    - Keyboard Controller
    - Printer Controller
    - Others
  - Mass Storage Peripheral
    - Floppy Disk Controller
    - Hard-Disk Controller
    - Optical Disk Controller
    - Others

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COMPONENTS

- Communications Peripheral
  - LAN
  - ISDN
  - Modem
  - Serial I/O
  - UART/USART
  - Others
- Floating-Point Coprocessor
  - 16-bit
  - 32-bit
- MOS Logic
  - MOS ASIC
    - MOS Gate Array
    - MOS PLD
      - MOS PLA
      - MOS PMD
      - MOS FPGA
    - MOS Cell-Based IC
  - MOS Custom IC
  - MOS Standard Logic
  - Other MOS Logic
- Analog Integrated Circuit
  - Monolithic Analog IC
    - Linear IC
      - Amplifier IC
      - Voltage Regulator
      - Voltage Reference IC
      - Comparator IC
      - Special-Function IC
      - Special Consumer IC
      - Special Automotive IC
      - Linear Array/ASIC
    - Mixed Signal IC
      - Data Converter IC
      - Telecommunication IC
      - Interface IC
      - Switch/Multiplexer IC
      - Disk Drive IC
      - Mixed Signal ASIC
  - Hybrid Analog IC

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COMPONENTS

- Discrete Semiconductor
  - Transistor
    - Small Signal Transistor
    - Power Transistor
      - Bipolar Power Transistor
      - MOS Power Transistor
      - Insulated Gate Bipolar Transistor
  - Diode
    - Small Signal Diode
    - Power Diode/Rectifier
  - Thyristor
  - Other Discrete Semiconductor
- Optoelectronic Semiconductor
  - Light-Emitting Diode/Display
  - Optocoupler
  - CCD
  - Laser Diode
  - Photosensor
  - Solar Cell
- III-V Semiconductor
  - GaAs Digital IC
  - GaAs Analog IC
  - III-V Discrete Transistor
  - Optoelectronic IC
- Passive Component
  - Cable
  - Capacitor
  - Cathode Ray Tube (CRT)
  - Connector
  - Inductor
  - Potentiometer
  - Relay
  - Resistor
  - Socket
  - Splice (Optical)
  - Transducer
  - Liquid Crystal Display
  - Switch

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BOARDS AND SUBSYSTEMS

- Graphic Board
  - Mac-Type Add-On Graphic Board
  - IBM-Type Add-On Graphic Board
- Imaging Subsystem
  - Add-On Memory Board
  - Controller Board
    - Storage Controller Board
    - Printer Controller Board
  - Magnetic Recording Head
  - Board-Level Computer
- Storage Subsystem

EQUIPMENT

- Data Processing Equipment
  - Computer Systems by Product Segment
    - General-Purpose Computer System
      - Supercomputer
        - Corporate Supercomputer
        - Departmental Supercomputer
        - Research Supercomputer
      - Mainframe Computer
      - Midrange Computer
        - Superminicomputer
        - Minicomputer
        - Microcomputer
      - Workstation Computer
        - Graphic/Project Supercomputer
        - Superworkstation
        - Traditional Workstation
        - Entry-Level Workstation
      - Personal Computer
        - Desktop Personal Computer
        - Desk-Side Personal Computer
        - Transportable Personal Computer
        - Laptop A/C Personal Computer
        - Laptop D/C Personal Computer
        - Notebook D/C Personal Computer
        - Pen-Based Personal Computer

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EQUIPMENT

- Hand-Held Personal Computer
- Special-Purpose Computer System
- Data Storage Device
  - Flexible Disk Drive
    - Fixed Media
      - Sub-3.5-Inch Disk Drive
        - 0 to 30MB
        - 31 to 60MB
        - 61 to 100MB
        - 101 to 200MB
        - 201 to 500MB
        - 501+MB
      - 3.5-Inch Disk Drive
        - 0 to 30MB
        - 31 to 60MB
        - 61 to 100MB
        - 101 to 200MB
        - 201 to 500MB
        - 501 to 1,000MB
        - 1,001+MB
      - 5.25-Inch Disk Drive
        - 0 to 30MB
        - 31 to 60MB
        - 61 to 100MB
        - 101 to 200MB
        - 201 to 500MB
        - 501 to 1,000MB
        - 1,001+MB
      - 8 to 10.5-Inch Disk Drive
        - 0 to 30MB
        - 31 to 60MB
        - 61 to 100MB
        - 101 to 200MB
        - 201 to 500MB
        - 501 to 1,000MB
        - 1,001+MB
      - 14-Inch Disk Drive
        - 0 to 30MB
        - 31 to 60MB

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EQUIPMENT

14-Inch Disk Drive (Continued)
61 to 100MB
101 to 200MB
201 to 500MB
501 to 1,000MB
1,001+MB

Rigid Disk Drive
Fixed Media
Sub-3.5-Inch Disk Drive
0 to 30MB
31 to 60MB
61 to 100MB
101 to 200MB
201 to 500MB
501+MB

3.5-Inch Disk Drive
0 to 30MB
31 to 60MB
61 to 100MB
101 to 200MB
201 to 500MB
501 to 1,000MB
1,001+MB

5.25-Inch Disk Drive
0 to 30MB
31 to 60MB
61 to 100MB
101 to 200MB
201 to 500MB
501 to 1,000MB
1,001+MB

8 to 10.5-Inch Disk Drive
0 to 30MB
31 to 60MB
61 to 100MB
101 to 200MB
201 to 500MB
501 to 1,000MB
1,001+MB

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EQUIPMENT

- 14-Inch Disk Drive
  - 0 to 30MB
  - 31 to 60MB
  - 61 to 100MB
  - 101 to 200MB
  - 201 to 500MB
  - 501 to 1,000MB
  - 1,001+MB
- Removable Media
  - Sub-3.5-Inch Disk Drive
    - 0 to 30MB
    - 31 to 60MB
    - 61 to 100MB
    - 101 to 200MB
    - 201 to 500MB
    - 501+MB
  - 3.5-Inch Disk Drive
    - 0 to 30MB
    - 31 to 60MB
    - 61 to 100MB
    - 101 to 200MB
    - 201 to 500MB
    - 501 to 1,000MB
    - 1,001+MB
  - 5.25-Inch Disk Drive
    - 0 to 30MB
    - 31 to 60MB
    - 61 to 100MB
    - 101 to 200MB
    - 201 to 500MB
    - 501 to 1,000MB
    - 1,001+MB
  - 8 to 10.5-Inch Disk Drive
    - 0 to 30MB
    - 31 to 60MB
    - 61 to 100MB
    - 101 to 200MB
    - 201 to 500MB
    - 501 to 1,000MB
    - 1,001+MB

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EQUIPMENT

14-Inch Disk Drive
- 0 to 30MB
- 31 to 60MB
- 61 to 100MB
- 101 to 200MB
- 201 to 500MB
- 501 to 1,000MB
- 1,001+MB

Dual Media

Sub-3.5-Inch Disk Drive
- 0 to 30MB
- 31 to 60MB
- 61 to 100MB
- 101 to 200MB
- 201 to 500MB
- 501+MB

3.5-Inch Disk Drive
- 0 to 30MB
- 31 to 60MB
- 61 to 100MB
- 101 to 200MB
- 201 to 500MB
- 501 to 1,000MB
- 1,001+MB

5.25-Inch Disk Drive
- 0 to 30MB
- 31 to 60MB
- 61 to 100MB
- 101 to 200MB
- 201 to 500MB
- 501 to 1,000MB
- 1,001+MB

8 to 10.5-Inch Disk Drive
- 0 to 30MB
- 31 to 60MB
- 61 to 100MB
- 101 to 200MB
- 201 to 500MB
- 501 to 1,000MB
- 1,001+MB

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EQUIPMENT

- 14-Inch Disk Drive
  - 0 to 30MB
  - 31 to 60MB
  - 61 to 100MB
  - 101 to 200MB
  - 201 to 500MB
  - 501 to 1,000MB
  - 1,001+MB
- Optical Disk Drive
  - CD-ROM
  - WORM Optical Disk Drive
    - 5.25 Inch
    - 8 to 12 Inch
    - 14 Inch
  - Rewritable Optical Disk Drive
    - 2 to 5.25 Inch
    - 8 to 12 Inch
  - Optical Jukebox
- Tape Drive
  - 1/4-Inch Tape Drive
    - Start-Stop
    - Streamer
      - 8 Inch
      - 5.25 Inch
      - 3.5 Inch
  - 1/8-Inch Tape Drive
    - Cassette
    - Cartridge
  - 1/2-Inch Tape Drive
    - 1/2-Inch Vacuum Column
    - 1/2-Inch Tension Arm
    - 1/2-Inch Streaming
    - 1/2-Inch Cartridge
  - Reel-to-Reel Tape Drive Recap
  - Helical Scan Tape Drive
    - VHS
    - DAT
    - 8mm
    - Others
- Input/Output Device
  - Terminal
    - Alphanumeric (CRT) Terminal
      - Minicomputer-Based Terminal

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EQUIPMENT

- Alphanumeric (CRT) Terminal (Continued)
  - Non-IBM, Protocol-Specific Terminal
  - IBM 3270 Protocol Terminal
  - Host/Vendor-Independent Terminal
  - Processing Terminal
- Graphics Terminal
- Point-of-Sale Terminal
- Funds Transfer Terminal (ATMs)
- Smart Card
- Other Specialized Terminal

Electronic Printer
- Serial Printer
  - Serial, Impact, Dot Matrix Printer
    - Dot Matrix Printer by Speed
      - 0 to 180 cps
      - 181 to 250 cps
      - 251 to 399 cps
      - 400+ cps
    - Dot Matrix Printer by Size
      - Total < 9 Wire (Pin)
      - Total 9 Wire (Pin)
      - Total 18 Wire (Pin)
      - Total 24 Wire (Pin)
  - Serial, Impact, Fully Formed Printer
    - 0 to 30 cps
    - 31+ cps
  - Serial, Nonimpact, Direct Thermal Printer
  - Serial, Nonimpact, Thermal Transfer Printer
    - Wax-Based
    - Sublimation
    - Dry Silver
  - Serial, Nonimpact, Ink Jet Printer
- Line Printer
  - Line, Impact, Dot Matrix Printer
    - 0 to 450 lpm
    - 451 to 650 lpm
    - 651+ lpm
  - Line, Impact, Fully Formed Printer
    - 0 to 450 lpm
    - 451 to 650 lpm
    - 651 to 1,050 lpm

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EQUIPMENT

- Line, Impact, Fully Formed Printer (Continued)
  - 1,051 to 1,250 lpm
  - 1,251+ lpm
- Line, Nonimpact, Direct Thermal Printer
- Line, Nonimpact, Thermal Transfer Printer
- Page Printer
  - 0 to 6 ppm
  - 7 to 10 ppm
  - 11 to 15 ppm
  - 16 to 20 ppm
  - 21 to 30 ppm
  - 31 to 50 ppm
  - 51 to 80 ppm
  - 81 to 150 ppm
  - 151+ ppm
- Other Input/Output Devices
  - Monitor
  - Remote Batch, Job-Entry, and Output
  - Key Entry Equipment
  - Media-to-Media Data Conversion
  - Magnetic Ink Character Recognition (MICR)
  - Optical Scanning Equipment
  - Computer Plotters
    - Small Format Pen Plotter
    - Large Format Pen Plotter
    - Small Format Electrostatic Plotter
    - Large Format Electrostatic Plotter
    - Ink Jet Plotter
    - Thermal Plotter
    - Photosensitive Plotter
    - Laser Plotter
  - Voice Recognition Computer Device
  - Voice Synthesizer
  - Mouse
  - Keyboard
  - Digitizer
- Office Equipment
  - Copier and Duplicator
    - Personal Copier (Up to 12 cpm)
    - Segment 1 (Up to 20 cpm)

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EQUIPMENT

- Copier and Duplicator (Continued)
  - Segment 2 (21 to 30 cpm)
  - Segment 3 (31 to 44 cpm)
  - Segment 4 (45 to 69 cpm)
  - Segment 5 (70 to 90 cpm)
  - Segment 6 (91+ cpm)
- Full-Color Copiers
- Electronic Calculator (without Alpha Keyboard)
- Dictating, Transcribing Machine
- Electronic Typewriter
- Word Processor
- Banking System
  - Check-Handling System
- Cash Register
- Mailing, Letter-Handling, Addressing Equipment
- Other Office Equipment

Communications

- Telecommunicatons
  - Image Communications
    - Facsimile
      - Classification by Type
        - Standalone Systems
        - PC Facsimile Cards
        - LAN to Fax Gateways
      - Classification by Technology
        - Group I
        - Group II
        - Group III
        - Group III Bis
        - Group IV
      - Classification by Feature
        - Ultra Low End
        - Low End
        - Midrange
        - High End
      - Classification by Price
        - <$1,000
        - $1,000 to $1,499
        - $1,500 to $1,999
        - $2,000 to $2,499
        - $2,500 to $2,999
        - $3,000 or More

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EQUIPMENT

- Classification by Printing Technology
  - Thermal
  - Thermal Transfer
  - Plain Paper (Laser, LED, etc.)
- ISDN Terminals
- Servers
- Teleconferencing
  - Audio
  - Video
    - Captured Image
    - Near-Full Motion
    - Codecs
    - PX64
  - Telex
    - Machines
    - Black Boxes
    - Gateways
    - Message Switches
  - Videotex
    - Terminals

Personal Communications

- Mobile Radio
  - Cellular Handsets
    - Classification by Type
      - Car-Mounted
      - Transportable
      - Portable
    - Classification by Technology
      - Analog
        - C450
        - NMT450
        - NMT900
        - TACS
        - ETACS
        - Radiocom 2000
        - AMPS
        - RTMS–Italy
      - Digital
        - GSM
        - Others

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EQUIPMENT

- Cordless Handsets
  - CT0
  - CT1
  - CT2
  - CT3
  - DECT
  - GSM
  - Base Stations
- Global Positioning Systems
- Mobile Infrastructure
  - Base Stations
- Personal Communications Networks (PCN)
  - Mininetworks
- Public Mobile Radio (PMR)
- Paging Systems

Networking

- Cable (Private)
- Data PBX
- Encryption Units
- Front-End Processors
  - IBM and IBM-Compatible
  - Proprietary
- ISDN
- Local Area Networks (LANs)
  - Terminal Servers
    - Ethernet
    - Token Ring
    - Others
  - PC Network Operating Software
  - PC LANs
  - Classification by Type
    - IBM PC/Compatible
    - Apple Macintosh
  - Classification by Technology
    - 802.3
    - 802.5
    - Arcnet
    - FDDI
    - Others
  - Classification by Media
    - Coaxial
    - Unshielded Twisted Pair (UTP)
    - Fiber-Optic
    - Datagrade

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EQUIPMENT

- Local Operating Network Systems (LONs)
- Modems
  - Classification by Standards
    - U.S. Standards
      - 212 A
      - V.22 Bis
      - 201 B/C
      - 208 A/B
      - V.29
      - V.32
      - V.33
      - 16.8 Kbps
      - 19.2 Kbps
      - V.35
      - V.36
        - Proprietary Dial-Up 9.6 Kbps
    - European Standards
      - V.21/23
      - V.21/23 PC
      - V.22
      - V.22 PC
      - V.22 Bis
      - V.22 Bis PC
      - V.26
      - V.27
      - V.29 Basic
      - V.29 Premium
      - V.32
      - V.32 PC
      - Proprietary Dial-Up 9.6 Kbps
      - V.33
      - 16.8 Kbps
      - 19.2 Kbps
      - Proprietary Baseband
      - Proprietary DOVE
- Multiplexers
  - Classification by Technology
    - Time Division (TDM)
      - Low-End Point-to-Point/Dual Trunk
      - Low-End Networking
      - Channels Banks/Primary MUX
      - T1/E1 Point-to-Point/Dual Trunk

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EQUIPMENT

- Time Division (TDM) (Continued)
  - T1/E1 Network Access
  - High-End Networking
  - Greater than T1/E1
- Statistical Time Division (STDM)
  - Classification by Size
    - Low End (Up to 16 Channels)
    - Midrange (Up to 48 Channels)
    - High End (More than 48 Channels)

Network Management Systems
- Public
  - Carrier
  - Local
  - Long Distance
- Private
  - LANs
  - T1/E1
  - X.25
  - Modems
  - Voice (Call Accounting)
  - Switch and Patch
  - Matrix
  - Mini/Mainframe-Based
  - Test Equipment
    - Analyzers
  - Operator Support Systems

Network-Terminating Devices

Operator Support Systems

Other Datacom Equipment
- Fiber-Optic Multiplexers

Public Data Network Systems (Equipment)
- X.21 Switches

Servers

Value-Added Networks (Equipment)

X.25
- Classification by Type
  - Packet Assemblers/Disassemblers (PADs)
    - Asynchronous Only
    - Synchronous Only
    - Multiprotocol
  - Packet Switches (Nodes)

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EQUIPMENT

- Classification by Capacity
  - Low End (Up to 100 Packets per Second)
  - Midrange (Up to 1,000 pps)
  - High End (More than 1,000 pps)
- Public Network Equipment
- Cable
  - Coaxial
  - Fiber-Optics
    - Monomode
    - Multimode
  - Multipair
- Cable TV
- Carrier Equipment
- Central Office
  - Classification by Type
    - Local
    - Trunk
    - Gateway
  - Classification by Technology
    - Analog
    - Digital
      - ISDN
        - Basic Rate Interface (BRI)
        - Primary Rate Interface (PRI)
    - Others
  - Classification By Size
    - Less than 2K Lines
    - 2K to 10K Lines
    - More than 10K Lines
- Digital Access Crossconnect Systems (DACS)
  - Classification by Type
    - 1/0 DCS
    - 1/1 DCS
    - 3/1 DCS
    - 3/1/0 DCS
    - 3/3 DCS
    - 4/1 DCS
    - 4/3 DCS
    - 4/4 DCS
    - OCN/OCN

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EQUIPMENT

- Classification by Capacity
  - Low End
  - Midrange
  - High End
- Fiber-Optic Terminal (FOTs)
- Line Conditioners
- Main Distribution Frame (MDF)
- Connectors
- Microwave
  - Classification by Type
    - Systems
    - Antenna
    - Accessories
    - Electronics
  - Classification by Usage
    - Short Haul
    - Long Haul
  - Classification by Technology
    - Analog
    - Digital
- Multiplexers
  - Classification by Type
    - Multiplexers
    - Fiber-Optic Terminals
  - Classification by Technology
    - Analog
    - Digital
  - Classification by Standards
    - European/CEPT Standard
      - 2 Mbps
      - 8 Mbps
      - 34 Mbps
      - 140 Mbps
      - 565 Mbps
      - 2.4 Gbps
    - U.S. Standard
      - 1.5 Mbps
      - 6 Mbps
      - 45 Mbps
      - 90 Mbps
      - 135 Mbps
      - 1.2 Gbps

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EQUIPMENT

- SONET
- Synchronous Digital Hierarchy (SDH)
- Asynchronous Transfer Mode (ATM)
- Fast Packet Switching
- Frame Relay

Network Termination Units
- ISDN
- DSU/CSU
- NTU

Operating Support Systems
Pay Phones
Public Paging Systems
Local Loop Equipment
- Analog
  - PCM Repeaters
  - Digital
- Twisted Pair
- SLC-96 and Compatibles
- Others
- Fiber Optics
  - Universal Digital Line Carrier (UDLC)
  - Integrated Digital Line Carrier (IDLC)
  - Flexible Access System (FAS)
  - SONET
  - 802.6 Metropolitan Area Network (MAN)
  - Others
- Wireless
  - Basic Exchange Telephone Radio Service (BETRS)
  - Cordless

Satellite Communications
- Space Stations
- Earth Stations
  - VSAT
  - Master—Hub
  - Remote
    - Receive Only—Data Broadcast
    - Interactive
- Direct Broadcast
- Teleport
- Television Receive Only
- Video Distribution

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EQUIPMENT

- Satellite Communications (Continued)
  - Home
  - Intelsat
  - Eutelsat
  - Others
- Signaling
- Telex
  - Low End (Less than 20 Ports)
  - Midrange(20 to 80 Ports)
  - High End (More than 80 Ports)
- X.25
  - Classification by Size
    - Low End
    - Midrange
    - High End

- Voice Communication
  - Answering Machines
  - Attendant Consoles
  - Automatic Call Distributors (ACDs)
    - Classification by Type
      - Standalone
      - Integrated
      - Analog
      - Digital
    - Classification by Capacity
      - 1 to 8 Agent Positions
      - 9 to 24 Agent Positions
      - 25 to 48 Agent Positions
      - 49 to 100 Agent Positions
      - More than 100 Agent Positions
  - Business Communications Systems
    - Classification by Type
      - Private Branch Exchange (PBX)
      - Key Telephone System (KTS)
    - Classification by Technology
      - Analog
      - Digital
      - ISDN
        - Terminals
        - ISDN
        - Proprietary
        - Servers
      - Network
        - BRI

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EQUIPMENT

- Network (Continued)
  - PRI
  - Proprietary
  - Gateways
- Basic

Classification by Capacity
- 1 to 8 Lines
- 9 to 24 Lines
- 25 to 48 Lines
- 49 to 100 Lines
- 101 to 400 Lines
- 401 to 1,000 Lines
- More than 1,000 Lines

Cable (Private)

Call Management Systems
- Centrex
- KTS
- PBX

Integrated Voice/Data Workstations (IVDT)

Intercom Systems

ISDN Terminals
- Voice
- Data
- Video
- Integrated

Private Paging Systems

Trading Turrets/Dealer Boards

Voice-Messaging Systems

Classification by Capacity
- 1 to 4 Ports
- 5 to 8 Ports
- 9 to 16 Ports
- 17 to 32 Ports
- 33 to 64 Ports
- 65 to 128 Ports
- More than 128 Ports

Voice Response Units (VRUs)

Classification by Capacity
- 1 to 4 Ports
- 5 to 8 Ports
- 9 to 16 Ports
- 17 to 32 Ports
- 33 to 64 Ports
- 65 to 128 Ports
- More than 128 Ports

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EQUIPMENT

- Voice Terminals
  - Classification by Type
    - Corded
    - Cordless
  - Classification by Technology
    - Analog
    - Digital
      - Pulse Dial
      - Tone Dial (DTMF)

- Industrial Electronic Equipment
  - Security/Energy Management
    - Alarm System
      - Intrusion Detection Alarm System
      - Fire Detection Alarm System
        - Discrete Device, Security/Energy Management
  - MPU Load Programmer
  - Computerized Energy Control System

  - Manufacturing System
    - Wafer Fabrication Equipment
      - Lithography Equipment
        - Proximity/Contact Aligners
        - Projection Aligner
        - Steppers
        - Direct-Write E-Beam
        - Maskmaking E-Beam
        - X Ray

      - Automatic Photoresist Processing Equipment
      - Etch-and-Clean Equipment
        - Wet Process
        - Dry Strip
        - Dry Etch
        - Ion Milling

      - Deposition Equipment
        - Chemical Vapor Deposition
        - Physical Vapor Deposition
        - Silicon Epitaxy Deposition
        - Metalorganic CVD Deposition
        - Molecular Beam Epitaxy Deposition
        - Diffusion
        - Rapid Thermal Processing

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EQUIPMENT

- Ion Implantation
  - Medium Current Ion Implantation
  - High-Current Ion Implantation
  - High-Voltage Ion Implantation
- Optical CD/Wafer Inspection
- Other Process Control Equipment
- Factory Automation Equipment
- Other Water Fabrication Equipment

Test Equipment
- ATE (Automatic Test Equipment)
  - Discrete Component Tester
  - Semiconductor Tester
  - Interconnect/Bare PCB Tester
  - In-Circuit PCB Tester
  - Functional PCB Tester
  - Combined PCB Tester
  - Manufacturing EATE N/A
- General Test Equipment

Process Control System
- Process Control System, Controller
- Process Control System, Recorder
- Process Control System, Indicator
- Process Control System, Auxiliary Station
- Process Control System, Nonunified System
- Process Control System, Industrial Process

Programmable Machine Tool
- Boring Programmable Machine Tool
- Drilling Programmable Machine Tool
- Grinding Programmable Machine Tool
- Horizontal Turning Programmable Machine Tool
- Vertical Turning Programmable Machine Tool
- Milling Programmable Machine Tool
- Machining Center Programmable Machine Tool
- Other Cutting Programmable Machine Tool
- Punch/Shear/Bend Programmable Machine Tool
- Flexible Manufacturing System Programmable Machine Tool

Mechanical Assembly Equipment

Plastic Processing Machinery

Robot System
- Robotic Electronic Assembly
- Robotic Nonelectronic Assembly

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EQUIPMENT

- Robot System (Continued)
  - Material-Handling/Loading Robot System
  - Painting Robot System
  - Spot-Welding Robot System
  - Arc-Welding Robot System
  - Machining Robot System
  - Other Robot System
- Automated Material Handling
  - Guided Vehicle
  - Programmable Conveyor
  - Storage/Retrieval Automatic Material-Handling System
  - Programmable Monorail
  - Warehousing
  - Programmable Overhead Crane
  - Other Automated Material-Handling Equipment
- Instrumentation
  - Integrating and Totalizing Meter for Gas
  - Counting Device
  - Digital Panel Meter
  - Analog Panel Meter
  - Panel Type Instrument
  - Elapsed-Time Meter
  - Portable Electronic Measuring Instrument
  - Electronic Recording Instrument
  - Physical Property Test, Inspection, and Measurement
  - Commercial Meteorological and General-Purpose Instrument
  - Nuclear Radiation Detection and Monitoring
  - Surveying and Drafting Instrument
  - Ultrasonic Cleaners, Drill
  - Meteorological Instrument
  - Geophysical Instrument
  - Analytical and Scientific Instrument
- Medical Equipment
  - Diagnostic Medical Equipment
    - Automatic Blood Analyzer
    - CAT Scanner
    - Digital Radiography
    - Electrocardiograph
    - Electroencephalograph
    - Magnetic Resonance Imaging

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EQUIPMENT

- Medical Equipment (Continued)
  - Respiratory Analysis
  - Ultrasonic Scanner, Medical
  - X Ray, Medical
  - Other Diagnostic Medical Equipment
- Patient-Monitoring
- Prosthetic Medical Equipment
  - Hearing Aid
- Surgical Support
- Therapeutic
  - Defibrillator
  - Dialysis, Diathermy
  - Electrosurgical
  - Pacemaker
  - Ultrasonic Generator
  - Other Therapeutic Medical Equipment
- Other Industrial Electronic Equipment
  - Vending Machine
  - Laser System (Excluding Communication)
  - Power Supply
  - Traffic Control
  - Particle Accelerator
  - Industrial and Scientific X Ray
  - Laboratory and Scientific Apparatus
  - Teaching Machine and Aid
  - Scientific Not Elsewhere Classified
- Consumer Electronic Equipment
  - Audio Consumer
    - Audio Amplifier
    - Compact (Disc) Player, Music
    - Consumer Radio
    - Stereo (Hi-Fi) Component
    - Stereo Headphone
    - Electronic Musical Instrument
    - Tape Recorder, Consumer
  - Video, Consumer
    - Video Camera, Consumer
    - VTRs (VCRs)
    - Videodisc Player

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EQUIPMENT

Video, Consumer (Continued)
- Color Television
- Black-and-White Television
- HDTV
- Remote Control
- LCD Television

Personal Electronic
- Game
- Camera
- Watch
- Clock
- Toy
- Sewing Machine
- Other Personal Electronic

Appliance
- Air Conditioner
- Microwave Oven
- Washer and Dryer
- Refrigerator
- Dishwasher, Disposal
- Range and Oven, Consumer
- Rice Cookers
- Fans
- Heaters
- Vacuum Cleaners
- Food Processors
- Other Consumer Appliance

Other Consumer Electronic
- Automatic Garage Door Opener
- Residential Smoke Alarm
- Consumer Electronic Equipment Not Elsewhere Classified

Military/Aerospace Electronic Equipment

Military Electronic Equipment
- Radar, Military
- Sonar, Military
- Missile-Weapon
- Space Military Equipment
- Navigation, Military
- Communication, Military
- Electronic Warfare

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EQUIPMENT

- Military Electronic Equipment (Continued)
  - Reconnaissance
  - Aircraft System
  - Military Computer System
  - Simulation and Training, Military
  - Miscellaneous Military Equipment
- Civil Aerospace
  - Radar, Civilian
  - Civilian Space
  - Civil Navigation/Communication
  - Civil Aircraft Flight System
  - Civil Simulation and Training
- Transportation Electronic Equipment
  - Entertainment, Transportation
  - Body Controls
  - Driver Information
  - Powertrain
  - Safety and Convenience
- Other Electronic Equipment

SOFTWARE

- Application Software (See Applications Segmentation)
- System Software
  - Operating System Software
    - Database
      - Document Management
      - Data Acquisition and Control
      - Storage Management
      - Database Administration
      - On-Line Transaction Processing
    - Development Tools
    - Editors
    - Language
      - Compilers
      - Assemblers
      - Translators
      - Data Translator
      - Query Languages

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SOFTWARE

- Interactive Languages
  - Fourth-Generation Languages
  - Visual Programming Languages
- Graphic
- Communication Management
  - User Interface
  - Device Interface
- Protocol
- Security
- Operating Environment
- Operating System
  - Proprietary
    - IBM/VM/MVS
    - DEC VMS
    - Others
  - Open
    - UNIX
      - OSF1
      - Sun OS
      - System V/BSD
      - Mach
      - XENIX
      - Others
        - Pick
        - Theos
        - Others
    - Real-Time
  - PC
    - DOS
    - OS/2
    - Macintosh
    - Others
  - Operating Utilities
    - Peripheral I/O Management
    - System Subroutine Libraries
    - Data Center and System Management
    - Information Resource Management
    - Information Center
    - System Utilities

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CONSUMABLES

- Paper
  - Cut Sheet
  - Form
  - Label
- Toner and Developer
- Print Ribbon
- Photoreceptor
- Print Element
  - Printwheel
  - Golf Ball
  - Thimble
- Computer Storage Media
  - Flexible Disk
  - Rigid Disk
  - Computer Storage Tape
  - Optical Media
- Transparency
- Other Consumable

SERVICES

- Telecommunications Services
  - Core Services
    - Classification by Type
      - Local Telephone Services
      - Long Distance Services
      - International Services
    - Classification by Technology
      - Analog
      - Digital
        - ISDN
          - HO
          - BRI
          - PRI
        - Others
    - Classification by Product
      - Toll Revenue
      - WATS Outgoing
      - WATS Incoming (800 Service)
      - 900 Service
      - Switched Digital Services
        - Switched 56 Kbps
        - X.21

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SERVICES

- Classification by Product (Continued)
  - Analog Private Lines
    - Conditioned
    - Unconditioned
  - Digital Private Lines
    - Classification by Capacity
      - 0 to 19.2 Kbps
      - 19.2 Kbps to 64 Kbps
      - 64 Kbps to H11
      - H11 to 772 Kbps
      - T1
      - E1
      - 8 Mbps
      - T3
      - 34 Mbps
      - More than T3
  - Centrex
    - Classification by Type
      - ETN
      - ACD
      - CLASS
      - Routing
      - Billing
      - Network Management
    - Classification by Size
      - 1 to 8 Lines
      - 9 to 24 Lines
      - 25 to 48 Lines
      - 49 to 100 Lines
      - 101 to 400 Lines
      - 401 to 1,000 Lines
      - More than 1,000 Lines
  - B-ISDN
  - Operator Services
- Enhanced Services
  - Audiotex Access Services
  - Voice Mail
  - Cable TV
  - Directory Inquiry
  - Electronic Messaging
    - X400
    - EDI
    - Others

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SERVICES

- ISDN
- Public Data
- Satellite
  - VSAT
  - Others
- Teleconferencing
- Teleport Services
- Telex Services
- Facsimile Services
- Value-Added Networks (VANs)
- VideoConferencing
  - Ad Hoc
  - Carrier Provided
- Virtual Private Network Services
- Videotex Access Services
- X.25
- Voice Messaging

- Mobile Services
  - Cellular
    - Classification by Technology
      - Analog
        - C450
        - NMT450
        - NMT900
        - TACS
        - ETACS
        - Radiocom 2000
        - AMPS
        - RTMS-Italy
      - Digital
        - GSM
        - Others
  - Cordless
    - Portable
      - CT2
      - CT3
      - DECT
    - Mobile
      - GSM
  - Global-Positioning Systems
    - Location Identification Systems

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SERVICES

- Personal Communications Networks (PCN)
  - SubGSM
- Public Mobile Radio (PMR)
  - Data Services
- Public Paging Systems
- Messaging Services
- Hardware Maintenance
  - Contract Maintenance
  - Time and Materials
- Parts
- Software Support
- Customer Training/Education
- Network Support
- Professional
  - Systems Integration
  - Facilities Management

OTHER PRODUCTS

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Geographic Regions

The geographic regions segmentation shows the classification scheme used by Dataquest to define the regions of the world. Dataquest classifies the world into the following regions:

- North America
- Europe
- Japan
- Rest of Asia—Rest of World

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Geographic Regions

Worldwide



North America
Europe
Japan
Rest of Asia—Rest of World

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North America



North America
- **United States**
  - East North Central Division
    - Illinois
    - Indiana
    - Michigan
    - Ohio
    - Wisconsin
    - East North Central Other
  - East South Central Division
    - Alabama
    - Kentucky
    - Mississippi
    - Tennessee
    - East South Central Other
  - Mountain Division
    - Arizona
    - Colorado
    - Idaho
  - Mountain Division (Continued)
    - Montana
    - Nevada
    - New Mexico
    - Utah
    - Wyoming
    - Mountain Other
  - Middle Atlantic Division
    - New Jersey
    - New York
    - Pennsylvania
    - Middle Atlantic Other
  - New England Division
    - Connecticut
    - Maine
    - Massachusetts
    - New Hampshire
    - Rhode Island
    - Vermont
    - New England Other

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United States (Continued)

Pacific Division
- Alaska
- California
- Hawaii
- Oregon
- Washington
- Pacific Other

South Atlantic Division
- Delaware
- District of Columbia
- Florida
- Georgia
- Maryland
- North Carolina
- South Carolina
- Virginia
- West Virginia
- South Atlantic Other

West North Central Division
- Iowa
- Kansas
- Minnesota
- Missouri
- Nebraska
- North Dakota
- South Dakota
- West North Central Other

West South Central Division
- Arkansas
- Louisiana
- Oklahoma
- Texas
- West South Central Other

Puerto Rico Division
- Puerto Rico

United States Other

Canada

North America Other

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Europe



Western Europe

Western Europe Major

- France
- Germany
- Italy
- Netherlands
- Spain
- Sweden
- United Kingdom

Western Europe Other

- Austria
- Belgium
- Cyprus
- Denmark
- Finland
- Gibraltar
- Greece
- Iceland
- Ireland
- Liechtenstein
- Luxembourg
- Malta
- Monaco
- Norway
- Portugal
- San Marino
- Switzerland

European Community (EC)

- Belgium
- Denmark
- France
- Germany
- Greece
- Ireland
- Italy
- Luxembourg

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European Community (EC) (Continued)
- Netherlands
- Portugal
- Spain
- United Kingdom

European Free Trade Association (EFTA)
- Austria
- Finland
- Iceland
- Norway
- Sweden
- Switzerland

Eastern Europe
- Albania
- Bulgaria
- Czechoslovakia
- Hungary
- Poland
- Romania
- Union of Soviet Socialist Republics
- Yugoslavia

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Japan



Japan

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Rest of Asia—Rest of World



Rest of Asia—Rest of World

Four Tigers

- Hong Kong
- Korea
- Singapore
- Taiwan

Other Asia

- Bangladesh
- Brunei
- Burma
- Cambodia
- China
- East Timor
- India
- Indonesia
- Laos
- Macau
- Malaysia
- Maldives
- Nepal
- Pakistan
- Philippines
- Sri Lanka
- Thailand
- Vietnam

Rest of World

Australia/New Zealand

- Australia
- Christmas Island
- Cocos Islands
- New Zealand
- Norfolk Island

Oceania

- American Samoa
- Canton and Enderbury Islands
- Cook Islands
- Fiji
- French Polynesia

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Oceania (Continued)
- Guam
- Johnson Island
- Kiribati
- Midway Islands
- Nauru
- New Caledonia
- Niue
- Pacific Islands
- Papua New Guinea
- Pitcairn
- Samoa
- Solomon Islands
- Tokelau
- Tonga
- Tuvalu
- Vanuatu
- Wake Island
- Wallis and Futuna Islands

Africa

Central America

Caribbean

Middle East

South America

Atlantic

Inner Asia

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Distribution

The distribution segmentation outlines the path by which a product moves from the manufacturer to the ultimate end user. This segmentation is used by Dataquest to analyze markups, discounts, and buyer behavior.

Dataquest defines the major distribution classifications as follows:

- Distribution channel
- Distribution method

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Distribution

DISTRIBUTION CHANNEL

- Direct
- Indirect
  - Value-Added Reseller/Systems Integrator
  - Original Equipment Manufacturer
  - Distributor
    - Regional Bell Operating Company (RBOC)
      - Independent Telephone Company
      - Telephone Interconnect Supplier
  - Dealer
  - Mass Merchandiser
  - Manufacturers' Representatives/Agents

DISTRIBUTION METHOD

- Direct Sales Force
- Telemarketing
- Mail Order
- Company-Owned Store

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Applications

The applications segmentation describes the use to which a product is put or the function it performs. Sometimes there are one-to-one relationships between products and their applications and the actual functions that a product performs.

The major applications as defined by Dataquest are as follows:

- General productivity
- Organizational
- Entertainment
- Industry specific

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Applications

GENERAL PRODUCTIVITY

- Document/Media Creation and Editing
  - Computer-Aided Printing and Publishing
    - Electronic Publishing
    - Technical Publishing
  - Graphics
    - Chart and Map Generation
    - Image Generation
    - Graphic Design Art
      - Image Editing
      - Draw/Paint
      - Image Capture
      - Clip Art
      - Illustration
    - Presentation Graphics
  - Color Prepress
    - Input
    - Image Processing
      - Image Manipulation
      - Color Correction
      - Color Pagination
    - Composition and Translation
    - Color Separation
  - Page Composition and Page Makeup
    - Page Description
    - Page Imaging
    - Document Architecture
    - Desktop Publishing
    - Scientific Visualization/Simulation
  - Multimedia
    - Animation
    - Desktop
      - Video
        - Compression
        - Digitizer
        - Full-Motion
        - Real-Time
      - Videodisc

The segmentation represents Dataquest's view of the high-technology marketplace and is not intended to represent the availability of data.

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GENERAL PRODUCTIVITY

- Holography
- Photo Realism
- Information Retrieval

- Forms

- Publishing Utilities
  - Tagging
  - PostScript Printing
  - Compression/Decompression
  - File Translation/Data Conversion

- Document Management
  - Author/Editor
  - Image Processing
  - Scanning
    - Text
    - Image
  - Word Processing
  - Typography

- Communication
  - Electronic Mail

- Spreadsheet/Decision Support/Executive Information Systems
  - Spreadsheet
  - General-Purpose Simulation
  - Modeling
  - Forecasting

- Learning/Education/Training
  - Instructional
    - Computer Training/Assisted Instruction
  - Educational Simulation
  - Learning

- Project Management
  - Calendaring
  - Scheduling
  - Ticketing
  - Library Management

- Time Management
  - Application Utilities
  - Integrated Applications
  - Relational Database Management System

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ORGANIZATIONAL

- Management and Administration
  - Accounting
    - Accounts Payable
      - Checkbook Management
    - Accounts Receivable
      - Billing/Invoicing
    - General Ledger
    - Payroll
    - Tax Accounting
    - Personal Finance
  - Capital Assets
    - Fixed Assets
    - Lease Accounting
  - Human Resource/Personnel Management
    - Benefits Administration
    - Employment Administration
  - Finance
    - Financial Planning
    - Budgeting
    - Cost Accounting
    - Investment/Portfolio Management
    - Cash/Money Management
    - Deposit/Loan Management
    - Treasury/Stocks/Bonds
  - Purchasing
    - Contract Administration
    - Vendor Management
  - Planning
    - Business Planning
    - Strategic Planning
    - Command, Control, Communications, and Intelligence
  - Facilities Management
    - Facility Planning
    - Facility Simulation
    - Equipment/Maintenance Management
    - Property/Real Estate Management
    - Facility Security Management

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ORGANIZATIONAL

- Sales and Marketing
  - Marketing Research
  - Advertising and Promotional
  - Public Relations
  - Order Entry/Processing
    - Customer/Prospect Management
      - Credit Management
    - Sales Support/Administration
- Research, Engineering, and Development
  - Industrial Automation
    - Shop Floor Plan and Control
    - CAM/Automated Assembly
    - Manufacturing Engineering Tools
    - Other Planning and Control
    - Test and Measurement
    - Others
  - Design Automation
    - CAD/CAM/CAE
      - Modeling
        - Two-Dimensional
        - Three-Dimensional
        - Solid
      - Mechanical
        - Documentation/Drafting
          - Detail Drafting
          - Document Management
          - Schematics
          - Technical Illustration
          - Charts
        - Conceptual Design
          - Industrial Design
          - Design Layout
          - Styling
        - Functional Design
          - Component
          - Assembly Verification
          - Linkage/Mechanism
        - Analysis
          - Fatigue
          - Structural

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ORGANIZATIONAL

- Analysis (Continued)
  - Thermal
  - Vibrational
  - Magnetic
  - Composite
  - Mass Property
- Manufacturing Engineering
  - Tool Design
  - Fixture Design
  - Part-Processing Design
- Manufacturing Process Simulation
  - NC Part Programming
  - Coordinate Measuring Machines
  - Off-Line Robotics
  - QC Analysis
- AEC (Architectural, Engineering, and Construction)
  - Architectural
  - Civil
  - Facility Design
  - Process Plant Design
- Geographical Information Systems
  - GIS/Mapping
  - Raster-Based GIS Systems
- Electronic Design Automation
  - Electronic Computer-Aided Engineering
    - Digital Design
      - Design Entry
        - Schematic Entry
        - Libraries
      - Design Verification
        - Simulation
        - Simulation Acceleration
        - Hardware Modeling
        - Static Timing Analysis
      - Logic Synthesis
      - Test Automation
        - Automatic Test Vector Generation
        - Design for Testability/Test Synthesis
        - Fault Simulation

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ORGANIZATIONAL

- Analog Design
  - Design Entry
    - Schematic Capture
    - Libraries
  - Design Verification
    - Circuit Simulation
    - Mixed Signal Simulation
- IC Layout and Verification
  - Editing
  - Layout
  - Verification
  - Module Generation
- PCB Layout

Software Development
- Computer-Aided Software Engineering
- Artificial Intelligence
- General Software Development

Earth Resources
- Seismic Analysis
  - Geophysical Seismic Imaging
- Oil Field Services
- Remote Sensing

Technical Data Analysis
- General Scientific
  - Scientific Research/Analysis
  - Scientific Visualization
  - Scientific Simulation
- Chemistry
  - Crystallography
  - Modeling
  - Analysis
- Simulation
- Laboratory
- Analytical Instruments
- Instrument Automation
- Quality Control/Assurance
- Research and Laboratory Analysis
- Others

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ORGANIZATIONAL

- Medical
  - Body Scanning
  - Patient Monitoring
  - Others
- Diagnostic
- Therapeutic

Manufacturing and Distribution
- Distribution Planning and Control
  - Transportation/Fleet Management
    - Route Planning
    - Dispatching
  - Warehouse Management
    - Automated Warehousing and Materials Handling
  - Inventory and Distribution Management and Control

Manufacturing Planning and Control
- Material/Process Requirements Planning, Production and Process Management
- Shop Floor Planning and Control
- CAM/Automated Assembly
- Manufacturing Engineering Tools
- Other Planning and Control
  - Simulation
    - Robot Programming and Simulation
  - Quality Assurance
    - Detection and Tracking
  - Fault Management/Adaptive Control
- Test and Measurement
- Inspection
  - Machine Vision

Others
- Real-Time Data Acquisition and Control
  - Simulation
  - C^3i
  - Others
- Building Automation

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ORGANIZATIONAL

Others (Continued)
- Traffic Control
- Railroad Control
- Power Grid Control
- Water Quality and Sewage Control
- Atmospheric Monitoring

ENTERTAINMENT

INDUSTRY SPECIFIC

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User Environment

The user environment segmentation is based on industry classifications derived from a format that reflects the United States Department of Commerce's Standard Industrial Classification (SIC) code scheme and the International Standard Industrial Classification of all economic activities used by the United Nations.

Environments are a description of where a product is used ultimately. The major user environments as defined by Dataquest are as follows:

- Home
- Business
- Education
- Government

Dataquest has a classification scheme available at the two-, three-, and four-digit SIC levels, which can be provided on request.

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User Environment

HOME

BUSINESS

Natural Resources and Construction
- Agricultural Production—Crops
- Agricultural Production—Livestock
- Agricultural Services
- Forestry
- Fishing, Hunting, and Trapping
- Metal Mining
- Coal Mining
- Oil and Gas Extraction
- Nonmetallic Minerals, except Fuels
- General Building Contractors
- Heavy Construction, except Building
- Special Trade Contractors

Process Manufacturing
- Food and Kindred Products
- Tobacco Products
- Textile Mill Products
- Lumber Wood Products
- Paper and Allied Products
- Printing and Publishing
- Chemicals Allied Products
- Petroleum and Coal Products
- Rubber and Miscellaneous Plastics Products
- Leather and Leather Products
- Stone, Clay, and Glass Products
- Primary Metal Industries

Discrete Manufacturing
- Apparel and Other Textile Products
- Furniture and Fixtures
- Fabricated Metal Products
- Industrial Machinery and Equipment
- Electronic and Other Electric Equipment
- Instruments and Related Products

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BUSINESS

Discrete Manufacturing (Continued)
- Miscellaneous Manufacturing Industries
- Transportation Equipment

Transportation
- Railroad Transportation
- Local and Interurban Passenger Transit
- Trucking and Warehousing
- Water Transportation
- Transportation by Air
- Pipelines, except Natural Gas
- Transportation Services

Communication
- Communication

Utilities
- Electric, Gas, and Sanitary Services

Wholesale Trade, Durable Goods
- Wholesale Trade—Durable Goods

Wholesale Trade, Nondurable Goods
- Wholesale Trade—Nondurable Goods

Retail Trade
- Building Materials and Garden Supplies
- General Merchandise Stores
- Food Stores
- Automotive Dealers and Service Stations
- Apparel and Accessory Stores
- Furniture and Home Furnishings Stores
- Eating and Drinking Places
- Miscellaneous Retail

Finance
- Depository Institutions
- Nondepository Institutions
- Security and Commodity Brokers

Insurance
- Insurance Carriers
- Insurance Agents, Brokers, and Service

Real Estate
- Real Estate
- Holding and Other Investment Offices

Hotels And Other Lodging
- Hotels and Other Lodging

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BUSINESS

Business Services
- Business Services
- Legal Services

Health Care
- Health Services

Other Services
- Personal Services
- Auto Repair, Services, and Parking
- Miscellaneous Repair Services
- Motion Pictures
- Amusement And Recreation Services
- Social Services
- Museums, Botanical, Zoological Gardens
- Membership Organizations
- Engineering and Management Services
- Services, NEC

EDUCATION

Elementary
Secondary
Higher Education
Four-Year Institution
Two-Year Institution
Public
Private

GOVERNMENT

Government by Function
- Executive, Legislative, and General
- Justice, Public Order, and Safety
- Finance, Taxation, And Monetary Policy
- Administration of Human Resources
- Environmental Quality and Housing
- Administration of Economic Programs
- National Security and International Affairs

Government
- Federal
- State
- Local

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SIZE (BUSINESS, EDUCATION, GOVERNMENT)

Revenue (Millions of U.S. dollars)
- 0 to 99.9
- 100 to 499.9
- 500 to 999.9
- 1 to 4.9
- 5 to 9.9
- 10 to 49.9
- 50+

Employees
- Small
  - 0 to 9
  - 10 to 19
  - 20 to 49
- Medium
  - 50 to 99
  - 100 to 249
- Large
  - 250 to 499
  - 500 to 999
  - 1,000+

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Research Items

The research items segmentation is a listing of general terms used by Dataquest to organize, describe, and analyze data for technology markets and industries. A typical use of research items is to describe market data in terms of shipments, retirements, and installed base.

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Research Items

Application
Assembler
Average Selling Price
Average Usage
Average Volume
Balance of Trade
Bit
Byte
Capital Spending
Captive Production
Compound Growth Rate
Consumption
Conversion Revenue
Cost
End User
End-User Average Selling Price
End-User Revenue
Environment
Export
Factory Average Selling Price
Factory Revenue
Gross Lease Additions
If-Sold Value
Import
Industry
Input/Output (I/O) Ratio
Installed Base
Internal Transfer
Inventory
Joint Venture
Lease
Lease/Rental Conversions
List Price
Manufacturer
Manufacturer's Suggested Retail Price
Market
Market Share
Markup
Merchant Production
Net Additions
New Placement Demand
Placement
Product
Product Category
Production
Replacement Demand
Research and Development
Residual Value
Retirement
Return
Revenue
Shipment
Subsidiary
Tie Ratio
Unit
Useful Life
Users per System
Year-Average Population

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Glossary

This glossary includes definitions of the major terms associated with Dataquest's segmentation of the high-technology marketplace.

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III-V discrete semiconductor. 1: A semiconductor device with low noise, low power, and high power in the range of one-half watt to one watt. 2: A device of gate structures based on D-MESFET and E/D MESFET devices.

A

academic support. College expenditures that include expenditures for support services that are an integral part of the institution's primary missions of instruction, research, or public service. Includes expenditures for libraries, galleries, audio/visual services, academic computing support, auxiliary support, academic administration, personnel development, and course and curriculum development.

accounting software. 1: A software application that supports a system of recording and summarizing business and financial transactions and analyzing, verifying, and reporting results. 2: A software application used to manage an organization's money and/or assets. This type of software includes general ledger, accounts payable/receivable, and inventory control.

accounts payable (AP). An application that supports the accounts payable function, which is the amount owed by a business to its suppliers and other regular trading partners.

accounts receivable (AR). An application that supports the accounts receivable function, which is the amount owed to a business by its customers.

ACD. See **automatic call distributor.**

adaptive control. 1: The property of a control system that allows it autonomously to maintain a manufacturing or process environment within predetermined control limits. 2: A device with parameters that adjust automatically to compensate for changes in the dynamics of the process to be controlled.

add-on graphics board. A graphics board that is added to a basic computer to enhance the computer's current graphic capability.

add-on graphics board, Mac-type. Personal computers that were designed to run applications exclusively through a graphical user interface (i.e., windows, menus, and icons). Mac-type systems include Apple's Macintosh series (512E, Plus, SE, and II), Atari's ST series (524 and 1024), and Commodore's Amiga. This term also refers to peripherals intended for use in Mac-type systems.

add-on memory board. A printed circuit board populated with memory integrated circuits (IC), usually DRAMs or SRAMs, that plugs into personal computers via connectors on the central processing unit bus. These boards are used to increase central processing unit storage capacity.

AEC. See **architecture, engineering, and construction.**

aerial. See **antenna.**

AGVS. See **automatic guided vehicle system.**

AI. See **artificial intelligence.**

air conditioner. 1: An apparatus for controlling the temperature and humidity of air. 2: A broad field including numerous processes, among which are refrigeration, heating, ventilation and humidification, and electronic air filtering.

aircraft system (military). Electronic power devices used in airplanes to perform functions like flight control, communication and navigation, lighting computer system (including air data, mission and fire control), engine control, instrumentation, integral targeting system, associated test system, and integrated system.

alarm system. A system designed to warn of an intrusion, a fire, or other undesired occurrence. Alarm systems have three functions in common: detection, control, and annunciation signaling.

alphanumeric CRT controller. A character set of both letters and numbers that is used to control electron beams, which are used to present data in a visual form.

alphanumeric CRT terminal. A display terminal that provides character information to the operator.

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amateur radio. A radio used for two-way radio communications by private individuals. It is not used for enterprise activity.

AMH. See **automated materials handling.**

amplifier IC. A linear IC that provides a voltage or power gain to an applied signal.

analog. 1: Representation of data by means of continuously variable physical quantities, such as voltage, current, or frequency. 2: A circuit or system in which the output signals bear a continuous relationship to the input signals. 3: A representation of an event in another form, e.g., the representation of voice sounds as continuously variable electrical signals.

analog design verification. A software application that includes analog simulation, analog synthesis, monte carlo analysis, worst-case analysis, and parametric plotting.

analog loop. A nondigital portion of the telecommunications network.

analog panel meter. 1: An electrical switchboard or instrument board with continuously variable electrical signals known as analog signals. 2: A mounting plate for the controls and/or other parts of equipment, utilizing analog signals.

analysis. Separation of a whole into its parts; proof of a mathematical proposition by assuming the result and deducing a valid statement by a series of reversible steps. Includes mass properties, kinematic and dynamic mechanism analysis, structural, thermal, composite, fluids, and vibration analysis. Finite element and finite difference are common analysis technologies used.

analytical and scientific instrument. Instruments used to measure, access, control, and monitor objects and systems.

animation. A software application to present either continuous pictures or images or to present them in rapid succession.

answering machine. A device, hooked to a telephone, that can record and play messages as they pass through a phone when a user is unable to pick up the telephone.

antenna. 1: A conductor or system of conductors that serves to radiate or intercept energy in the form of electromagnetic waves. 2: A device for transmitting or receiving radio waves. Also called aerial.

AP. See **accounts payable.**

appliance. 1: An instrument or device designed for a specific household or office purpose. 2: A piece of equipment for adapting a tool or machine to a special purpose.

application. The use to which a product is put; the function it performs.

application software. A software program or set of programs designed for a specific application, such as inventory control or linear programming.

application-specific integrated circuit (ASIC). A single-user IC that is manufactured using vendor-supplied tools and/or libraries. (May be sold by an ASIC or standard-product group.)

application utilities. A software application that enhances the operation of other standalone applications; Typically operates concurrently with these standalone applications.

AR. See **accounts receivable.**

architectural. Computer-aided tools intended for use in design and drafting of facilities' architectural aspects.

architecture, engineering, and construction (AEC). The use of computer-aided tools by architects, contractors, plant engineers, civil engineers, and others associated with these disciplines to aid in designing and managing buildings, industrial plants, ships, and other types of nondiscrete entities.

arc-welding robot systems. A system in which a robot carries an arc-welding torch to produce welds.

argon. An inert gas extensively used in discharge tubes.

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artificial intelligence (AI). The ability of a machine to perform functions normally associated with human intelligence, such as learning, adapting, reasoning, self-correcting, and improving automatically.

ASCII. Standardized coding for alphanumeric and other standard keyboard characters.

ASIC. See **application-specific integrated circuit.**

ASP. See **average selling price.**

AS/RS. See **automated storage/retrieval system.**

assembler. A company that adds manufacturing value to a product.

assembly. 1: A group of subassemblies and/or parts that, when put together, create a major subdivision of the final product. When two or more components or subassemblies are put together by the application of labor and machine hours, it is called an assembly. An assembly may be an end product or a component for a higher-level assembly. 2: The semiconductor manufacturing steps of mounting a die in a package, bonding the pads to the package leads, and sealing the package.

assembly verification. The integration of various component designs into an assembly to test size/shape and functional characteristics.

asynchronous telecommunications software. A software application that emulates a standard computer terminal (e.g., DEC VT-100) and performs file transfer between asynchronously connected computers and/or provides remote operation of another computer.

ATE. See **automatic test equipment.**

ATM. See **automated teller machine.**

atmospheric monitoring. A real-time software application that monitors weather-related data from satellites and other monitoring sites around the world.

atmospheric/purge cylinder gas. A specialty gas; a cylinder gas for purging certain processing systems and equipment when manufacturers are concerned about possible back contamination of the house lines.

attendant console. A specialized telephone instrument that allows fast and efficient answering and routing of telephone calls.

audio amplifier. A device that uses transistors or vacuum tubes to obtain voltage, current, or power to amplify sound.

audio conferencing. The ability to communicate among more than two people at one time via a speakerphone or the telephone system/network.

audio equipment. Amplifiers, preamplifiers, control consoles, and other equipment used in studio, broadcast, and home environments. Equipment interprets frequencies corresponding to audible sound waves.

automated assembly system. The assembly of parts into subassemblies and/or complete assemblies using programmable equipment that may include robots. In discrete piece manufacturing, this system includes spot- and arc-welding and adhesives. In electronics, this system includes component placement and printed board component insertion. Usually, these automated assembly systems include sensors.

automated guided vehicle system (AGVS). An unmanned mobile transporter under programmable control that moves materials and tooling throughout a factory and/or warehouse. Includes towing vehicles, pallet trucks, light-load transporters, unit-load transporters, and self-loading and unloading vehicles.

automated materials handling (AMH). The automated handling of discrete or bulk materials in manufacturing systems. Materials handling includes the movement, storage, identification, and controlling of materials.

automated storage/retrieval system (AS/RS). All computer hardware, software, and equipment that are used together for mechanical hoists and carriages and that interface with racks and bins for automatic storage and retrieval of unit loads, pallets, and individual parts. An AS/RS moves materials from inventory to operations and back to inventory, frequently for work-in-process inventory.

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automated teller machine (ATM). A machine used by financial institutions and designed to perform many of the banking functions performed by human tellers. (See also **funds transfer terminal.**)

automatic blood analyzer. Equipment used to analyze, detect, and decipher blood types and blood-related diseases.

automatic call distributor (ACD). A computer-based system located at a customer's premises that: (1) provides real-time monitoring of a telephone system's work load; (2) distributes calls to the agent who is idle longest; and (3) uses a queuing or waiting list assignment that holds the callers in queue until an agent is available, averages the random flow of traffic, and decreases peak traffic load. An ACD also contains features known as gates or agent split groups that provide functional divisions within the routing scheme and allow calls to be directed to a specific group or agent.

automatic photoresist processing equipment (colloquial: track). Equipment used to dispense and process photoresist material onto a wafer. Track equipment, as this equipment is usually called, includes wafer clean/bake, wafer prime, wafer coat/bake, wafer develop/bake, and resist stabilization equipment.

automatic test equipment (ATE). Computer-controlled equipment that inspects electronic devices, both active and passive. ATE usually includes analytical and statistical data-reduction capabilities and can document test results by display, hard copy, and electronic storage. ATE can perform printed circuit board (PCB) inspection by mechanical, electrical, and visual means in an automatic, programmable mode. ATE includes both bare boards and boards that have been loaded with electronic devices. In the latter case, diagnostic capabilities are included as a part of the system definition if they are part of the equipment.

automatic warehousing system (AWS). A dedicated storage and retrieval system that is used not on the factory floor but in a warehouse that may or may not be located within a manufacturing facility. An AWS includes a control system and associated material-handling equipment and structures, but excludes the building unless it is a structural part of the automated system. The control system includes both hardware and software.

automation. The system or technique of the production process that minimizes human intervention. Self-controlled machines are used to accomplish human tasks or tasks not able to be accomplished by human intervention.

average selling price (ASP). The average price of a product, inclusive of any discounts. (See also **end-user ASP** and **factory ASP.**)

average usage. The average number of units of product used per unit of time.

average volume. The average number of units of product produced per unit of time.

awarded contract. A binding agreement granted to a specific company.

AWS. See **automatic warehousing system.**

B

balance of trade. 1: The difference between the value of a country's exports and imports of tangible goods over a given period, usually one year. 2: The difference between the value of a country or region's exports of tangible goods to and imports of tangible goods from a second country or region.

banking system. Systems used in the banking/finance industries to facilitate the transmission of funds to improve efficiencies. Systems include: payroll allocation and deduction; demand deposit accounting; savings, both regular and certificates of deposit; and loan processes.

baseband modem. A type of modem that utilizes all of the available analog bandwidth on a line.

basic exchange telecommunications radio system (BETRS). A radio system network that provides cost-effective basic telephone service within remote areas.

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benefits administration. A software application with the primary function of administering and aiding in managing an organization's employee benefits.

BETRS. See **basic exchange telecommunications radio system.**

BiCMOS. Bipolar complementary metal oxide semiconductor. See **BiMOS.**

BiMOS (BiCMOS). Bipolar metal oxide semiconductor (MOS). An integrated circuit (IC) manufactured with both bipolar and MOS processes that yields a component with the benefits of both technologies.

bipolar. 1: A semiconductor technology employing two junction transistors. 2: A device in which both majority and minority carriers are present. A transistor structure with electrical properties determined within the silicon material.

bipolar application-specific IC. See **application-specific integrated circuit.**

bipolar cell-based IC. See **cell-based integrated circuit.**

bipolar custom IC. See **custom integrated circuit.**

bipolar digital logic. See **logic circuit.**

bipolar digital microcomponent. See **microcomponent.**

bipolar FPGA. See **field-programmable gate array.**

bipolar gate array. See **gate array.**

bipolar memory. See **memory.**

bipolar nonvolatile memory. See **nonvolatile memory.**

bipolar PLA. See **programmable logic array.**

bipolar PLD. See **programmable logic device.**

bipolar PMD. See **programmable multilevel logic device.**

bipolar standard logic. See **standard logic.**

bipolar transistor. A transistor that uses positive- and negative-charge carriers. Bipolar transistors provide current gain—that is, a current input results in a larger current output.

bit. Abbreviation for binary digit. A unit of information equal to one binary decision, or the designation of one of two possible and equally likely values or states of anything used to store or convey information.

black-and-white television. Television in which the reproduced picture is displayed in shades of gray between black and white. Also known as monochrome television.

board-level computer. A single, or multiple, board-level CPU that is sold individually or incorporated in systems-level products (boxes). Typically, these are products that are not considered complete packaged systems. Prices range from the low hundreds to the low thousands of dollars. Frequently, software is bundled with the board for a specific application.

body control. Electronic equipment used to direct, manage, or guide an automobile or truck. Examples include electronic suspension, cruise control, intermittent wipers, load-sensitive braking, antitheft devices, electronic steering, and electronic mufflers.

book publishing software. Software with the main purpose/use of printing books or written or printed literary works.

boring programmable machine tool. A factory tool designed to machine internal work such as cylinders, holes, and castings.

broadband communications. Communications that utilize a bandwidth greater than a voice-grade circuit.

broadcast. 1: The transmission of packets on a contention bus where all data are heard by all devices on the channel and are selected by each device through address-recognition techniques. 2: To send messages or to communicate simultaneously with many or all points on a circuit. 3: The transmission of radio frequencies from a source to all devices that are capable of receiving the signal. Microwave transmission is one method of transmission. 4: Radio or television transmission intended for public reception.

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broadcast and studio equipment. Equipment used to make information public by means of radio or television.

broadcast transmitter antenna. An electronic device for generating and amplifying a radio-frequency carrier for transmission through space from an antenna.

bubble memory. A storage medium that allows information to be stored on magnetically charged crystal chips. Bubble memories can hold data without electricity to sustain them; blackouts, changes in current, and static charges do not affect them. Such memories process material 75 times as fast as disk memories. However, bubble memory processors cannot handle multiprogramming, i.e., performing parallel operations with several programs.

budgeting. An application that supports future resource planning.

building automation. A software application with the primary functions of managing the operations of a facility, including fire detection, energy management, and alarm systems. Large manufacturing plants and skyscrapers use real-time computers to control and monitor conditions. This may include fire detection and control systems; security systems; clocking, documenting, and energy management for heating, ventilation, and air conditioning.

bulk gas. A discrete delivery of gas in a liquid state.

bundled distribution and warehouse package. Hardware and/or software modules used for planning and control of warehouse or product distribution systems. These packages are not available separately from the total warehouse or distribution system.

business. A commercial or mercantile environment usually referred to as a vertical market. See "User Environment" section.

byte. 1: A single group of eight bits processed together. 2: The number of bits that a computer processes.

C

C³I. See command, control, communications, and intelligence.

cable. An assembly of one or more conductors within an enveloping protective sheath, constructed to permit the use of the conductors singly or in groups.

cable television equipment. All equipment for both the head and subscriber ends of a cable television system.

cache. A fast, small memory (typically SRAM) used to enhance CPU performance, separate from main processor memory.

cache controller. A device that governs the area of a system that stores only data the system may need in the immediate future.

CAD. See computer-aided design, drawing, or drafting.

CAE. See electronic computer-aided engineering and mechanical computer-aided engineering.

CAGR. See compound annual growth rate.

calculator. A device capable of performing logical and arithmetical digital operations of any kind.

calendaring. 1: An application to support the scheduling of meetings and other events. It is usually a tickler file, reminding people of upcoming commitments. 2: In the papering industry, paper with a hard, smooth finish.

call management systems. The equipment and service that records the calling activity of a centrex, PBX, or key telephone system in order to generate reports that support telephone cost allocation and other telephone management information needs.

call processing equipment. Call processing equipment provides additional functions and capabilities beyond traditional call processing. This classification includes add-on products such as voice-messaging systems, call accounting systems, and automatic call distributors.

CAM. See computer-aided manufacturing.

capacitor. A commonly used component that stores electrical energy. It is sometimes referred to as a condenser.

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capital assets. An application that assists a company in managing its capital assets, which are any physical property or right that is owned and has a money value.

capital spending. The purchase of a capital asset or an asset that is needed to create a product and is acquired with the intention of keeping (rather than being resold).

captive production. The sale of a good to a division within the manufacturing company.

carrier equipment. A cable-based system that provides transmission of multiple signals over a common metallic or fiber-optic cable. This segment includes subscriber carrier systems, trunk carrier systems, Basic Exchange Transmission Radio (BETR) systems, and repeaters.

cartography. An application that supports map production and/or resource management. May contain a spatially indexed data structure.

cartridge tape drive. A tape drive that uses a special metal and plastic protective device for the tape, which can be used for 1/4-inch or 1/2-inch tape products.

CASE. See **computer-aided software engineering.**

cash register. A device that automatically registers visibly the amount of a specific sale. Many are used to trace inventory and other product information through the sale of the product.

cassette tape drive. A tape drive that uses a small container of tape similar to that used for commercial audio recording purposes.

cathode ray tube (CRT). A television-like display screen which, on receipt of information bearing electronic signals, produces a visual display of the information (text, graphics). The CRT consists of a vacuum tube display in which a beam of electrons is projected onto a fluorescent surface of phosphors, producing a visual display. Used in most computer display terminals. Also referred to as video display terminal/visual display tube (VDT).

CAT scanner. A computerized axial tomography—frequently shortened to CT. A reconstructive imaging technique employing an X-ray source and array of detectors rotated about the body of the patient. The host computer calculates an image based on the appearance of a thin volume in the plane of the rotation.

CBIC. See **cell-based integrated circuit.**

CCD. See **charge-coupled device.**

CCIT. A French acronym for the International Telegraph and Telephone Consultative Committee, a committee of the international standards organization made up of telecommunication authorities of member countries. The committee's primary purpose is to develop and produce standards for telecommunication networks.

CCME. See **computational chemistry/molecular engineering.**

CCTV. See **closed circuit television.**

CD. See **critical dimension** and **compact disc.**

CD-ROM (compact disc read-only memory). See **CD-ROM disc drive.**

CD-ROM disc drive. All CD-ROM discs are 4.7 inches (12cm) in diameter, have a 1.6-micro-inch-pitch single-spiral track, and have 2.048 data bytes per sector.

cell-based integrated circuit (CBIC). An ASIC device that is customized using a full set of photomasks and uses automatic placement of cells and automatic routing.

cellular handset. See **cellular telephone.**

cellular service. One type of mobile communications, where a low-power radio is used between limited-distance "cells."

cellular telephone. Mobile radio equipment associated with cellular radio services.

central office (CO). 1: The physical location that contains the equipment that supports the telephone network. 2: The switching equipment that connects local access lines to toll circuits.

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central office switching equipment. Equipment comprised of electronic systems that interconnect local telephone lines (loops) and connect local telephone lines to long distance trunk lines.

central processing unit (CPU). A microprocessor or microcontroller. Central processing unit of a computer.

centrex. An optional service that provides voice/data switching by using the utility's central office.

charge-coupled device (CCD). ICs that combine charge-coupled signal transfer with arrays of photosensors to provide image sensing. CCDs are available as linear or area arrays.

chart. Any table, graph, or drawing depicting a range of technical data.

chart and map generation. A graphics software application that is designed specifically for charts and predefined maps.

check-handling system. A system to improve the speed and accuracy of check-handling processes within the banking and finance industries.

chemical vapor deposition (CVD). A formation of a stable compound on a heated substrate by thermal reaction or decomposition of gaseous compounds. A process that chemically isolates and deposits a specific material on a wafer. CVD equipment includes atmospheric-pressure CVD (APCVD), plasma-enhanced CVD (PECVD), and low-pressure CVD (LPCVD) techniques. Historically, the CVD market was split into APCVD, PECVD, and LPCVD technologies, because each had its own applications. Now, because of advanced reactors that are crossing application boundaries, it makes more sense to divide the market by film application rather than by equipment technology.

chemistry. 1: An application to support the science dealing with the composition structure and properties of substances and with the transformations that they undergo. 2: Chemical processes and phenomena.

circuit. 1: The electrical path between two or more points. 2: A means of two-way communication between two points, consisting of a sending and a receiving channel or a combined sending and receiving channel. 3: A transmission path between two or more points.

CISC MPU. See **complex-instruction-set computing microprocessor.**

citizens band: mobile and base. A frequency band allocated for private individual radio service (460 to 470 megahertz or 26.965 to 27.405 megahertz).

civil aerospace. Civilian travel in space.

civil aircraft flight system. Same as military aircraft, except related to civilian activity.

civil application. A software application used for civil engineering tasks, typically for design and drafting of sites for buildings, streets, highways, bridges, dams, airports, and utilities.

civilian space. Equipment used by civilians to explore the earth's atmosphere. Includes satellites, reconnaissance equipment, and ground control equipment.

civil navigation/communication. Same as military navigation/communications, except related to civilian activity.

civil radar. Same as military radar, except related to civilian activity.

civil simulation and training. Same as military simulation and training, except related to civilian activity.

closed circuit television (CCTV). A television system where television signals are not broadcast, but are transmitted over a closed circuit and received by interconnected receivers.

CMOS. See **complementary MOS.**

CO. See **central office.**

coaxial cable. Type of transmission cable with one or more central conductors, surrounded by an insulator.

CODEC. See **coder/decoder circuit.**

coder/decoder circuit. An integrated circuit that codes a voice signal into a binary waveform or decodes a binary waveform into a voice signal. Such circuits now are used in digital communications applications.

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college. A postsecondary school that offers general or liberal arts education, usually leading to an associate, bachelor's, master's, doctor's, or first professional degree. Junior colleges and community colleges are included under this category.

color prepress. A process that converts visual material to electronic signals.

color separation. A process of photographing objects using three filters, each corresponding in color and light transmission to one of the additive primary colors; analogous to seeing.

color television. An electronic system that transmits signals to a visual image that can be viewed in an array of colors on a screen.

combined elementary and secondary school. A school that encompasses instruction at both the elementary and secondary levels. Examples of combined elementary and secondary school grade spans would be 1 through 12 or 5 through 12.

combined PCB tester. Testing equipment that combines functional and in-circuit test techniques and capabilities that result in a test strategy to suit any given board's production history and fault spectrum to achieve the highest board fault coverage at the lowest cost.

command, control, communications, and intelligence (C^3I). Systems used to display the ongoing status of tactical or strategic operations in dynamic scenarios for rapid decision making.

commercial antenna. See **antenna.**

commercial meteorological and general-purpose instrument. Equipment used to obtain quantitative information about the weather.

communication. 1: The transmission of information from one point or person or equipment to another. 2: The sensing of a measurement signal or phenomenon for display, recording, amplification, transmission, computing, or processing into useful information.

communication management. The organization of stations, peripherals, and devices capable of intercommunications but not necessarily on the same channel.

communication peripheral. An interface device for machine-to-machine connections.

compact disc (CD). A disc from which data are read optically by means of a laser.

compact disc player. 1: A recording and playback system used to play recorded music by means of a small plastic optical disc similar to multiplex stereo broadcast and reception. Each wall of the record groove carries a single channel of information. 2: A recording device in which the sounds are mechanically impressed onto a disc.

comparator. A type of amplifier that produces a logic output (1 or 0) based on comparison of an input voltage with a fixed reference voltage. A widely used form of linear integrated circuit.

compiler. 1: Computer routine that translates symbolic instructions to machine instructions and replaces certain items with subroutines. 2: An automatic coding system in a computer that generates and assembles a program from instructions written by a programmer. 3: A computer language system consisting of various subroutines that have been evaluated and computed into one routine handled by a computer. 4: Software used to convert application programs from computer language to machine language.

complementary MOS. A semiconductor technology that uses both P-channel and N-channel transistors on the same silicon substrate to gain the primary advantages of very low power and high noise immunity.

complex-instruction-set computing (CISC) microprocessor. The number of instructions a microprocessor runs for a specific application. Known as a general-purpose processor.

component. An assembly, device, or piece of equipment that is part of a larger assembly or system.

component design. Design of the individual components in an assembly.

composite analysis. The analysis of composite materials (such as carbon fiber) as they change in the manufacturing process and are used in the final assembly.

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compound annual growth rate (CAGR). The average rate of growth compounded over a specified period. The formula used to calculate CAGR is:

$$\left(\frac{\text{Value in period 1+n}}{\text{Value in period 1}}\right)\left(\frac{1}{n}\right) - 1$$

computational chemistry/molecular engineering (CCME). The use of computers to model molecular structures, to predict physical properties of molecules, and to design new compounds for specific purposes.

computer-aided design (CAD). Systems that function as tools to expedite mechanical and electronic design. Most CAD systems consist of a graphics computer terminal linked with a computer and a software package with features that aid in design and drafting, keep track of parts, run simulations, and provide illustrated parts or circuit diagrams. Programs complete the layout, geometric transformations, projections, rotations, magnifications, and interval (cross-sectional) views of a part and its relationship with other parts.

computer-aided manufacturing (CAM). The use of computers to program, direct, and control production equipment in the fabrication of manufactured items.

computer-aided software engineering (CASE). A combination of artificial intelligence and structured programming techniques used to aid in the development of large software programs.

computerized energy control system. A system with the resources for producing heat, electricity, and/or power and the capability of running on computers.

computer plotter. A visual display on which a dependent variable is graphed by an automatically controlled pen or pencil or other image development device/technique as a function of one or more variables. See also **plotter.**

computer storage media. The substance upon which data are stored electronically. Media may be flexible disks, rigid disks, tape, or optical disks.

computer storage tape media. Long, thin, flexible tape appropriate for digital magnetic recording and storage of computer data.

computer system. A combination of hardware, software, firmware, and peripheral components that has been assembled to satisfy a particular goal or set of goals.

computer systems performance segments. The following are Dataquest segments for computer systems performance: Level I—low-performance minicomputers, microcomputers, and personal computers; Level II—medium-performance minicomputers and microcomputers, very low end workstations, and high-end personal computers; Level III—low-performance superminis, midrange workstations, and high-performance minicomputers; Level IV—midrange superminis, low-end mainframes, and high-end workstations; Level V—high-performance superminis and midrange mainframes; Level VI—low-end supercomputers and very high performance superminis; and Level VII—supercomputers and high-end mainframes.

computer to PBX interface/digital multiplex interface (CPI/DMI). Two different standards for communication between systems.

computer to plate. A process that merges type and black-and-white images and combines the functions of typesetting, camera photography, and contact platemaking.

conceptual design. An application that supports styling, industrial design, and other design applications emphasizing visualization, aesthetic, and ergonomic considerations.

connector. A device used to join or fasten transistors, establishing a relationship between active and passive devices.

consortium. An international business agreement; an association or society.

consumable. Material that is capable of being consumed.

consumer electronics. The application of electronics in consumer equipment.

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consumer integrated circuit (IC). An analog circuit that meets specific consumer end-market applications. These circuits are dedicated to specific applications, such as audio or radio, and would not be used for general purpose.

consumer N.E.C. Consumer equipment not elsewhere classified.

consumer radio. A device used by the general public for communication by electromagnetic waves transmitted through space to produce sound.

consumption. The markets' purchase and use of goods and services, including lease or rental.

contract administration. The management of agreements between a company and its vendors and/or customers.

contract maintenance service. Ongoing repair services based on agreed upon terms and conditions (such as hours of coverage and level of services) as stipulated in a written agreement between the customer and the service provider.

controller. A device or group of devices that serve to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

controller board. A printed circuit board that provides programmable logic that controls the sequence of operations of the functional stages of a peripheral device.

conversion revenue. The revenue generated by changing from an equipment rental contract to a purchase or lease contract.

coordinate measuring machine. Machine used to measure the physical dimensions of a part.

copier. A reproduction device designed to produce replicas of hard-copy originals. Copiers may use either an analog or a digital scanning system.

coprocessor. A logic device that operates in association with a microprocessor to enhance system performance. Coprocessors are not capable of independent operation.

cordless telephony. The transmission of speech or other information via radio, enabling two persons to converse over almost any distance without a connecting cord to a base unit.

corporate publishing. Publishing that supports the main business of an organization or person; printed and published products are produced in the normal course of operations, but not as a primary source of revenue.

corporate supercomputer. An information system priced at more than $2 million. Performance speed is more than 200 mflops; current upper limit is approximately 2 Gflops. Currently used mainly for batch applications, but the trend is toward interactive use. Optimized for very heavy, numerically intensive applications. Requires special environmental controls and cooling techniques.

cost. The expenditure necessary to produce a product.

cost accounting. An application that supports a branch of accounting that is concerned with the collection, determination, and control of costs, particularly those costs associated with producing products or services.

counter/timer circuit. A circuit that receives uniform pulses representing units to be counted and provides a voltage proportional to their frequency.

counting device. A device register or location in computer storage for storing numbers or number representations in a manner that permits these numbers to be increased or decreased by the value of another number or to be changed or reset to zero or to an arbitrary value.

CPE. See **customer premise equipment.**

CPI/DMI. See **computer to PBX interface/digital multiplex interface.**

CPU. See **central processing unit.**

critical dimension (CD). Refers to a line, element, or feature that must be manufactured and controlled to very tight specifications.

CRT. See **cathode ray tube.**

CT2. See **digital cordless telephone.**

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custom/contract programming. Programming services that include applications development and software systems conversions.

customer management. A software application used to maintain lists of purchasers of a company's products and services.

customer premise equipment (CPE). Telecommunication equipment used at an end user's location, as compared with use at the local telephone utility.

customer training/education service. Activities designed to instruct customers in the installation, usage, programming, management, and maintenance of hardware, software, and networking products.

custom integrated circuit. A handcrafted, single-user integrated circuit that is customized using a full set of photomasks and requires manual placement and routing. Can be either bipolar or MOS technology process.

CVD. See **chemical vapor deposition.**

D

daisywheel. See **printwheel.**

DAT. See **digital audiotape.**

data acquisition and control. See **real-time data acquisition and control.**

database. The entire body of data that has to do with one or more related subjects. Typically, it consists of a collection of data files stored in a computer system.

database administration. A control program function that provides access to data sets, enforcement of data storage conventions, and regulation of the use of input/output devices.

database management system (DBMS). 1: A software application that provides storage maintenance functions for data stored in sequential, hierarchical, relational, or object format. Example of DBMS products include FOCUS (hierarchical), Ingres (relational), and GBASE (object oriented). 2: A systematic approach to storing, updating, and retrieving information stored as data items, commonly referred to as data files.

database publishing. A system with the main purpose/use of printing the ordered collections of data.

data capture. A process that takes possession or control of information.

data center. A program designed primarily to acquire, analyze, process, store, retrieve, and disseminate one or more types of data.

data center construction/relocation services. Services in which a vendor performs or manages the contracting of site management services including the design and building of a customer's data center and/or the relocation and installation of customer's equipment.

datacom equipment. See **data communications equipment (DCE).**

data communications equipment (DCE). Equipment used for transmitting data between points of origin and reception. It includes products such as modems, statistical multiplexers, T-1 multiplexers, front-end processors, data PBX systems, data network management systems, DSU/CSU equipment, local area networks, and private packet data switching equipment.

data converter. An integrated circuit that changes alternating current to direct current or direct current to alternating current.

data creation. The process of producing or originating information.

data network management system. A product or device that diagnoses, isolates, reinstates, or accumulates information for network components or provides reports and analysis of network performance.

data PBX system. A digital private branch exchange system that allows terminals to switch and contend for computer ports by providing RS-232-C connections. This system does not provide voice switching. Data PBX base units and add-on channels also are included in this classification.

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data processing (DP). 1: The preparation of source media that contain data or basic elements of information and the handling of such data according to precise rules of procedures to accomplish such operations as classifying, sorting, calculating, summarizing, recording, and computing. 2: The handling of information in a sequence of reasonable operations.

data service unit (DSU) and channel service unit (CSU). These provide an interface to digital services, such as the AT&T Dataphone Digital Service (DDS).

data storage device. A product designed to hold data until needed. Storage devices are rated by technology (rigid, flexible, and optical disk drives and tape drives), physical size in inches (diameter for rigid and flexible disk drives, width for tape drives), and capacity in bytes. (See also **disk drive, tape drive.**)

data translation. 1: A device that transforms computer information to data from one language to another language without affecting the meaning. 2: To change one binary word to another.

DBMS. See **database management system.**

DCE. See **data communications equipment.**

dealer. 1: Independent businesses selling products under contract to one or more vendors. 2: A product reseller selling to end users. A dealer's primary added value is distribution; secondary added values are service, training, and support.

defibrillator. An electronic instrument used for stopping spontaneous, local contraction of muscle fibers (fibrillation) during a heart attack by applying controlled electronic pulses to the heart muscles.

departmental supercomputer. An information system with price ranging from $100,000 to $2 million. Performance speed ranges from 10 to 200 mflops. Acquired usually by users who need heavy number-crunching capabilities but cannot afford a full-scale supercomputer costing more than $2 million. This computer is a vector processor and thus uses a fundamentally different execution technique from scalar processors, such as mainframe computers and superminicomputers, and is typically configured as a uniprocessor rather than a parallel processor. Typical environment is a "cool room" with a raised floor and/or an ordinary office with no special environmental controls. Number of concurrent users typically ranges from 10 to 50.

deposition. The layering of various chemicals on a wafer. The introduction of dopant to wafers in high-temperature furnaces, chemical vapor deposition (CVD), sputtering, and implant.

deposit/loan management. An application that facilitates the control and earning potential of loans and deposits.

design layout. An initial design process in which the major components and part interfaces are defined.

desk-side personal computer. The desk-side personal computer meets all the qualifications listed for desktop personal computers but is further defined as being a personal computer that has been specifically designed to be placed next to or under the computer operating or desk surface, including foot/stand on bottom of system.

desktop personal computer. The desktop computer classification includes all personal computers except those products that are designed and sold as local area network servers, desk-side personal computers, and all forms of portable computers. Further, these systems are based on keyboard input devices.

desktop publishing. 1: Generalized computing platforms used to perform electronic publishing tasks as one of many applications. 2: The formatting of text and graphics into publishing-quality printed output.

desktop terminal equipment. Telecommunications equipment that is actually used on a desktop. This segment includes products such as single-line telephone equipment and integrated voice/data workstations.

desktop video. Tabletop televised images.

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detail drafting. The representation of a part in standard geometric drafting format. This representation will include all part geometry dimension and notations describing mechanical/structural, functional, and material characteristics.

detection and tracking. A real-time application that detects, tracks, and controls various systems and processes. (See also **data acquisition and control.**)

device interface. 1: An electronic device that enables one piece of gear to communicate or control another. 2: A device linking two incompatible devices. 3: A card containing circuits that allow a device to interface with other devices.

diagnostic. 1: Pertaining to the detection, discovery, and further isolation of a malfunction or mistake. 2: Medical applications that aid in diagnosing medical problems. X-rays, CAT scans, and ultrasound are examples.

dialysis. The separation of substances in solutions by means of their unequal diffusion through semipermeable membranes.

diathermy. The therapeutic use of high-frequency electric currents to produce localized heat in body tissue.

dictating/transcribing machine. A device that automatically records human speech onto a form of magnetic tape that can be played back for transcription.

diffusion. 1: A process used in the production of semiconductors that introduces minute amounts of impurities into a substrate material. 2: The movement of particles away from regions of higher concentration caused by the random thermal motion of atoms and molecules to areas of lower concentration.

digital. 1: Pertaining to the class of devices or circuits in which the output varies in discrete steps. 2: Circuitry in which data-carrying signals are restricted to either of two voltage levels, corresponding to logic 1 or 0.

digital access cross-connect system. A system that is composed of multiplex equipment that allows digital lines to be remapped electronically at a different digital level.

digital audiotape (DAT). A 4mm helical scan device (i.e., data recorded at an angle rather than parallel).

digital cordless telephone. Mobile telephone that uses digital radio transmission technology. CT2 is a standard for these devices.

digital design verification. A software application that includes logic simulation, timing analysis, hardware accelerators, hardware modelers, electrical rule checking, mixed signal simulation, transmission line simulators, and signal noise analysis.

digital panel meter. 1: An electrical switchboard or instrument board using continuously variable electrical signals known as analog signals. 2: Digital signals versus analog signals.

digital radiography. Equipment used for electronically detecting the arrival of X-ray photons transmitted through or emitted from an object on various media and converting the sensed analog signals to digital signals.

digital signal processor (DSP). High-speed general-purpose arithmetic unit used for performing complex mathematical operations such as Fourier transforms.

digitizer. A device used for the creation of digital information from alphanumeric or line artwork. More sophisticated digitizers are able to reproduce halftone images and usually are termed scanners.

diode. 1: A semiconductor device used to permit current flow in one direction in a circuit and to inhibit current flow in the other direction.

direct channel. The sale of equipment directly to the end user by a vendor that contributes significant development or integration to the product. Can be either sales of complete systems by turnkey vendors or sales of components of systems sold by individual suppliers.

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direct memory access (DMA). A computer feature, set up by the central processing unit (CPU), that provides for high-speed direct data transfer from a peripheral device to the computer memory or to magnetic disk or tape storage units. This feature releases CPU time to perform other procedures. Most DMA devices employ a CPU-cycle-stealing approach.

direct sales force. A sales method that employs a sales force to move a product through the distribution channel by making face-to-face contact with the consumer. Also referred to as outside sales.

direct thermal printer. A printer that uses point-specific heat and heat-sensitive substrate that change color when exposed to heat.

direct write e-beam. Equipment used in semiconductor manufacturing where electron beams are used to create heat that will expose selected areas of a wafer's surface to create a specific design. (See also **lithography.**)

disaster recovery and contingency planning. The planning and implementation of data backup and recovery procedures for a customer's site, based on an analysis of the critical business functions.

discrete component testers. Equipment used to test, check, and monitor the functionality of devices that have a single functional capability per package. These devices include resistors, capacitors, diodes, transistors, and other devices not classified as integrated circuits.

discrete device, security energy management. A circuit complete in itself used in the security and energy industries.

discrete semiconductor. An individually packaged semiconductor component complete in itself, such as a diode or transistor.

disk. 1: A high-capacity random-access storage device. Data are written onto and read from the surfaces of a stack of revolving record-like disks coated with magnetic material. May be fixed or removable. Capacity ranges from 0 to more than 1,000 pages per disk. Referred to as a rigid disk. (See also **random access.**) 2: A random-access magnetic storage medium in the form of a platter or thin wafer. (See also **magnetic disk.**)

disk drive. The unit that controls the reading and writing of disks.

disk drive IC. An analog IC designed for the mass-storage peripheral market. These ICs include read/write amplifiers, data separators, data processors, servo controllers, and motor controllers.

diskette (floppy disk). A record-like disk of magnetically coated Mylar enclosed in a protective square envelope. Holds from 80 to 250 pages of text. Unlike cassettes or cartridges, which store text serially, diskettes are formatted in a random manner, which allows faster access.

disk, magnetic. A storage device containing information recorded on the magnetizable surface of a rotating disk; a magnetic disk storage system is an array of such devices, with associated reading and writing heads mounted on movable arms.

disk operating system (DOS). 1: A computer system based on the Intel 80XX or 80XXX architecture that use the MS/PC-DOS operating system software. 2: An operating system that uses magnetic disks as its primary on-line storage.

dispatching. A software application used to execute the route plans of multiple vehicles, taking real-world events into account.

display peripheral. A component used to address the man-to-machine interface, whereas communication peripherals are used to address the machine-to-machine interface.

distribution. 1: The act or process of distributing. 2: The path by which a product moves from the manufacturer to the ultimate end user. 3: To place or position so as to properly apportion over or throughout an area.

distribution channel. The route taken either by the title to a product or by the physical product itself as it moves from the producer to the ultimate end user. The channel for a product extends to the last consumer who buys it without requesting any significant change in its form. When form is altered and another product emerges, a new channel is started.

distribution frame. A unit for terminating telephone wiring. This unit is typically used for terminating and cross-connecting telephones to the switching system.

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distribution method. A method employed to move a product through the distribution channel. It is separate and distinct from the channel in that many channel members may employ the same distribution method.

distributor. A wholesaler that sells to other resellers or end users. The distributor's primary function is to stock the inventory of multiple manufacturers to provide volume buying power to its end users.

DMA. See **direct memory access.**

documentation/drafting. A software application that includes detail drafting, schematics, technical illustration, charts, specifications, bills of materials, training manuals, and other drawing- or drafting-related applications. International standards such as ISO, DIN, or ANSI can be used to define text and feature format.

document management. A documentation system, generally computerized, that links and tracks all documents (drawings, procedures, specifications) related to an assembly or process.

dopant. Atoms of materials such as phosphorus, boron, or arsenic that are diffused into silicon to create resistors, diodes, and transistors.

DOS. See **disk operating system.**

dot matrix printer. A printer that produces images through selective printing of dots chosen from a dot array matrix. Dot matrix printers are segmented by the number of wires in the printhead: 9, 18, or 24 and greater wires. Within these technology segments, additional segments are defined by speed of printing, expressed in characters per second (cps).

DP. See **data processing.**

DRAM. See **dynamic random-access memory.**

DRAM controller. A device that governs DRAMs in some predetermined manner. Holds a process or condition at a desired level or status as determined by comparison of the actual value with the desired value.

drilling programmable machine tool. A machine tool fitted with an end-cutting tool that is rotated with sufficient power to create a hole or enlarge an existing hole in solid material.

drive. See **tape drive.**

drive, disk cartridge. A disk drive using a removable one- or two-platter cartridge; may incorporate a fixed-media capability.

drive, fixed Winchester. A disk drive that includes all fixed-media Winchester drives.

driver information. An electronic device used to assist the driver by giving visual or audio signals for direction. Examples include digital gauges, service reminders, digital clocks, trip/navigation computers, heads-up display, audio annunciator, CRT display, miles-to-empty indicator, and shift indicator.

dry etch. A technique in semiconductor manufacturing used to produce more uniform pattern definition on wafers without immersing the wafer in a liquid bath. Techniques include plasma etching and reactive etching through which gases and energetic ions remove unwanted chemical material from a wafer.

dry silver. A photosensitive film or paper coated with silver compounds that is developed by the application of heat. Popularized by 3M.

dry strip. A process in semiconductor manufacturing for removing photoresist from the wafer after etching. Dry strip comprises barrel strippers and single-wafer strippers.

DSMPU. See **DSP microprocessor.**

DSP. See **digital signal processing.**

DSP microprocessor (DSMPU). A general-purpose, programmable integrated circuit similar to a conventional microprocessor. Its distinction is characterized by the efficiency with which it implements repetitive multiplications and additions required by DSP algorithms.

DSU/CSU. See **data service unit (DSU) and channel service unit (CSU).**

DTMF. See **dual-tone multifrequency signaling.**

dual-disk drive. A system that provides for the use of two disks at the same time.

dual-tone multifrequency signaling (DTMF). A standard signaling method for touch-tone telephones using a combination of two different tones for any button pushed.

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duplicator. 1: A small offset printing press that uses a planographic image carrier. These presses are usually capable of one or two colors and are smaller, easier to operate, but less sturdy than offset presses. 2: Machine that requires a special master to make copies but produces copies at a higher rate of speed than copying. It differs from printing in that a direct-image master is used that yields a limited number of copies. Offset, spirit, gelatin hecto, stencil, and sometimes xerography are considered duplicating processes. (See also **copier.**)

dynamic random-access memory (DRAM). A random-access memory device that must be electrically refreshed frequently (many times each second) to maintain information storage. DRAM densities can range from 16K, with approximately 16,000 bits, to 16Mb, with approximately 16 million bits.

E

8mm tape cartridge. A class of tape drives using 8mm cartridges; used in camcorders.

E-1 multiplexer. An electronic device that consolidates or pools multiple digital streams representing voice or data signals onto a single high-speed E-1 data line. An E-1 line operates at 2.048 Mbits/second, a standard within Europe. See **T-1 multiplexer** for U.S. standard.

earth resources application. Studying the earth resources by performing seismic analysis, mapping, and oil field services.

EATE (electronic automatic test equipment). See **automatic test equipment.**

e-beam. A sophisticated system used in semiconductor manufacturing that uses an electron beam for maskmaking or for projecting patterns onto wafers. E-beam equipment allows smaller geometries (typically less than 1 micron) than are possible under other production methods.

ECAE. See **electronic computer-aided engineering.**

ECL. See **emitter-coupled logic.**

EDA. See **electronic design automation.**

education. The process of providing schooling or training by formal instruction and supervised practice.

educational publishing. A system with the main purpose/use of printing materials used for the process of educating.

EEPROM. See **electrically erasable programmable read-only memory.**

elapsed time meter. An electronic measuring instrument that counts the actual time taken to observe a recurring event.

electrically erasable programmable read-only memory (EEPROM). A nonvolatile memory device that can be erased and programmed electrically.

electrocardiograph. An instrument used to graphically record electrical manifestations of heart activity obtained from the body's surface.

electroencephalograph. An instrument used to graphically record electrical discharges of the cerebral cortex by electrodes attached to the surface of the scalp.

electronic calculator. A product with components that perform calculations and digitally display results. (See also **calculator.**)

electronic computer-aided engineering (ECAE). Computer-aided tools used in the engineering or design phase of electronic products (as opposed to the physical layout phase of the product). Examples of ECAE applications are schematic capture, simulation, and test pattern creation. ECAE systems are used most often by electrical engineers.

electronic design automation (EDA). Computer-based tools that are used to automate the process of designing an electronic product, including boards, ICs, and systems. Formerly referred to as ECAD.

electronic forms generation. The process of automatically producing documents requesting information.

electronic game. Home electronic games that typically are attached to television receivers.

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electronic keyboard. A keyboard on which characters are generated or encoded by electronic means, usually by contact closure, as opposed to mechanical linkages. Electronic keyboards have a different feel, and some have a built-in artificial bottoming feel and/or audible click to assure the operator a key actually has been depressed.

electronic mail (e-mail). An application that supports the movement of information between users connected to a networked computer system.

electronic musical instrument. An instrument that allows the transmission of musical sound by the use of transistors.

electronic publishing. Fully integrated automation of the printing procedure.

electronic warfare (EW). Electronic operations between enemies. Includes warning receivers, jammers, assorted electronic countermeasure systems, and associated test equipment.

electrostatic plotter. A plotter using the corona from high voltages applied to needles or nibs to produce shaped electrostatic charges on paper; toner is attracted to the charged area, and heat and pressure are used to fuse the toner to the paper.

elementary/secondary school. A regular school, defined as schools that are part of state and local school systems and most nonprofit private elementary/secondary schools, both religiously affiliated and nonsectarian.

e-mail. See **electronic mail.**

emerging technology. A technology that is not in widespread use and that appears to have potential for widespread acceptance.

emitter-coupled logic (ECL). 1: A form of integrated circuit used to implement very high speed logic functions. 2: The emitters of the input logic transistors are coupled to the emitter of a reference transistor.

employees. All civilians, who, during a reference time period, did any work for pay or profit (minimum of an hour's work) or worked 15 hours or more as unpaid workers in a family enterprise.

encryption. Process of encoding data, voice, or video transmissions for security purposes.

encryption unit. A device that encodes/decodes data, voice, or video transmissions for security purposes.

end user. The final purchaser of a finished product.

end-user average selling price. The average price that a user pays for a product inclusive of channel markups and discounts.

end-user revenue. End-user average selling price multiplied by shipment quantity.

enhanced service. Equipment and service charges associated with enhanced data communication networks, which may include protocol, electronic mail, or facsimile.

enrollment. In education, the total number of students registered in a given school unit at a given time, generally in the fall of a year.

entertainment system. 1: Electronic equipment used for amusement or pastime and not intended to, but may, increase productivity or skill. Examples include: radio, seek/scan, graphic equalizer, power amplifiers, noise reduction, cellular telephone, optical disk, CB radio, and digital audiotape. 2: A computer application to keep or hold the mind, something directing or engaging.

entry-level workstation. A low-cost computer workstation, priced less than $15,000. It is targeted at the end user who is sensitive to price. This segment tends to be dominated by occasional users who are not paid for producing documents on their system. Entry-level workstations mainly run 2-dimensional graphics and have a rating of less than 12 mips and a rating of 0.5 to 1.5 mflops.

environment. Where a product is used ultimately.

epitaxial wafer. Single-crystal silicon grown on a crystalline silicon substrate.

EPROM. See **erasable programmable read-only memory.**

equipment/maintenance management. A software application that assists in the management of equipment and the respective maintenance requirements and contracts. May also calculate depreciation.

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erasable programmable read-only memory (EPROM). A nonvolative memory device that can be erased by ultraviolet (UV) light and reprogrammed by the user.

ET. See **typewriter.**

etch-and-clean equipment. Equipment used in semiconductor manufacturing to remove and clean material from wafers.

EW. See **electronic warfare.**

expenditure. Charges incurred, whether paid or unpaid, which are presumed to benefit the current fiscal year. These include all charges for current outlays plus capital outlays and interest.

export. The delivery of products to a foreign country for the purpose of trade or sale.

F

fab. Abbreviation for wafer fabrication. See **fabrication.**

fabrication. A manufacturing operation that makes components rather than assemblies.

fabric ribbon. Fabric ribbons are struck repeatedly by the print mechanism until all the ink is depleted. Such ribbons are used commonly for general-purpose printing and are the most economical and durable ribbon substrate. Most fabric ribbons are made of nylon and are available in several forms, e.g., cartridge or web ribbon.

facilities design/management. A software application used to lay out, inventory, and manage assets (such as personnel, space, equipment, and utilities) within a building or geographic service area.

facilities management service. The responsibility of providing ongoing administration of a data processing or communications facility by a vendor.

facility planning and simulation. A facility system model is exercised and refined through a series of simulation steps until a detailed, optimum configuration is reached.

facsimile (fax). 1: An electronic device that uses telephone lines to transmit documents to and receive documents from a second facsimile machine. 2: An exact copy or the process of transmitting printed matter or still pictures by a system of either telephones, telegraph, or radio for reproduction.

factory automation equipment. Equipment that includes various types of capital equipment that are automated and used throughout a manufacturing facility.

factory average selling price. The average price per unit that is paid for a product. This figure takes into account discounts given to the distribution channel and multiple-purchase discounts.

factory revenue. The amount of money received by a manufacturer for its goods.

fast packet switch. A packet-switching technique in which small packets are switched at high-speed using hardware for the transport of voice, data, and video.

fast SRAM. A static RAM device that runs at speeds less than 70 nanoseconds. (See also **static random-access memory.**)

fatigue. In electronics, the degradation of the performance of materials, parts, or circuits with time.

fault detection, fault management, and adaptive control. A software application that determines if a manufacturing system or a process is functioning or performing within control limits. Fault management and adaptive control is a control method in which control parameters are continuously and automatically adjusted in response to measured process variables to achieve near-optimum performance.

fax. See **facsimile.**

FDDI. See **fiber distributed data interface.**

federal government. A form of government in which power is distributed between a central authority and a number of constituent territorial units.

FERRAM. See **ferroelectric random-access memory.**

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ferroelectric random-access memory (FERRAM). A nonvolatile, radiation-hard, fast read/write memory that can store data over long periods of time without power.

fiber distributed data interface (FDDI). A standard for high-speed packet switched data.

fiber optic. 1: The technique of transmitting light through long, thin, flexible fibers of glass, plastic, or other transparent material. Bundles of fiber can transmit complete images. 2: A technique used in electromagnetic wave propagation in which infrared and visible light frequencies are transmitted by a light-emitting diode (LED) or a laser through a low-loss glass fiber. This method is used in very high frequency (VHF) radiation transmission.

field-programmable gate array (FPGA). An integrated circuit incorporating an array of programmable logic elements that are not preconnected. Interconnections between the various elements are user programmable and consist of predetermined levels of interconnect that can be connected to, or disconnected from, other interconnect lines as defined by the user. Can be of either bipolar or MOS technology.

field-programmable logic array (FPLA). A logic array in which programming is accomplished by blowing fuse links or shorting base-emitter junctions.

film ribbon. See **single-strike ribbon** or **multistrike ribbon.**

finance. An application to support the management of money or other liquid resources and their respective management within an organization.

fixed asset. An application that supports the management of an organization's fixed assets, which are a capital asset that cannot be readily liquidated, such as plant, land, equipment, and long-term investments. Management of expected costs based on a specific level of production or other activity.

fixed disk. A memory disk that cannot be removed from the read/write device, as opposed to a removable hard disk, diskette, or magnetic tape.

fixed media rigid disk drive. A fixed media rigid disk drive has the platter enclosed in a housing that is not designed to be accessible to the user.

fixture design. The design of a variety of structural aids that hold the component or assembly during the manufacturing process.

flexible disk. See **flexible disk computer storage media.**

flexible disk computer storage media. A flexible disk made of a 3-mil polyester substrate coated with gamma ferric iron oxide particles dispersed in an epoxy binder and encased in a vinyl jacket. These are commonly supplied in 3.5- or 5.25-inch diameters.

flexible manufacturing system programmable machine tool. A manufacturing system that typically consists of a computer-integrated group of numerical control (NC) machines or workstations linked with material transfer devices for complete automatic processing of differing product parts or the assembly of these parts into different units.

floating-point coprocessor. A separate microprocessor used in the efficient handling of floating-point operations.

floppy (flexible) disk. A small, thin, electromagnetic media used for storing digital information.

floppy disk controller. A device controlling the storage and retrieval of data from a floppy disk.

font generation. Process whereby typeface and size is selected.

font management. The understanding, use, and control of fonts or typefaces that are displayed on a terminal or monitor, or printed out on a device such as a printer, plotter, or typesetter. Font management requires the understanding of the physical location of where the fonts reside—whether in diskette, hard disk, ROM, RAM, card, or cartridge. It also requires the knowledge of the type of font—whether bit map or outline, scalable or fixed point and pitch—and the applications and print system capability to address and place the fonts accurately on the screen or printing media.

forecasting. To estimate in advance or anticipate; to predict future events, trends, business conditions, etc.

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form. 1: Any material that has been printed for the primary purpose of facilitating the entry of written information by hand or machine. A form has repetitive information printed in fixed positions. Blank paper may be included, especially if it is continuous and has undergone some alteration such as punching or perforating to facilitate manual or machine entries. 2: Allows the user to graphically design a form for publication—may include data entry and database capabilities.

four-year institution. An institution legally authorized to offer and that does offer at least a four-year program of college-level studies wholly or principally creditable toward a baccalaureate degree.

FPGA. See **field-programmable gate array.**

FPLA. See **field-programmable logic array.**

front-end processor. A computer-based product expressly designed to relieve host computers of certain communications processing tasks. Included are remote concentrators that are not attached directly to a host computer. This segment does not include general-purpose computer systems functioning as front-end processors.

full-color copier. A reproductive device that can recognize the full range of colors on an original and reproduce them using the three subtractive primary colors and produce a full-color copy.

fully formed printer. A printer that prints fully formed characters by applying pressure on or to the paper and obtaining the characters from a wheel, band, type train, or drum. Such devices can be serial, fully formed printers and line, fully formed printers.

functional design. An application that supports component design, assembly verification, linkage and mechanism design, and other detail or functional design activities.

functional PCB tester. An equipment tester that accesses the normal input/output interface of the unit under test (UUT). Generally, this consists of the edge-connector pins, plus any special interface that may have been provided for testing. Provides stimulus patterns and measurement verification that the UUT actually operates correctly.

funds transfer terminal. A machine used by financial institutions and designed to perform many of the banking functions performed by human tellers. (See also **automated teller machine.**)

G

GaAs. See **gallium arsenide semiconductor.**

GaAs analog IC. There are two overlapping subsets in this segment; analog products and monolithic microwave integrated circuits (MMICs). Analog products have output that are linearly proportional to their inputs and function at a varying range of frequencies across the spectrum, depending on particular device design. MMICs operate in the microwave frequency spectrum (above 3 GHz).

gallium arsenide semiconductor (GaAs). A compound of gallium and arsenic used as a semiconductor material. GaAs devices are relatively expensive devices exhibiting very low internal noise and very high speed.

game. A software application or activity engaged in for diversion or amusement.

gas. A consumable material used throughout the fabrication of semiconductor devices. Includes both bulk and specialty gases.

gate array. 1: An ASIC device that is customized using the final layers of interconnect. (Included in this category are generic or base wafers that include embedded functions such as static RAM.) May be of either bipolar or MOS process technology.

gateway. Equipment or conceptual point that connects two otherwise incompatible systems. (See also **protocol converter.**)

general analysis. A software application designed to solve various technical problems and to further research subjects. The analysis is usually mathematical in nature and performed by scientists, physicists, chemists, biologists, and engineers.

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general ledger. A software application that supports the business function of entering accounting transactions and their subsequent transferring and reporting.

general operating system. An operating system with use not restricted to a particular type of computer or a specialized application.

general productivity. A software application that is used to enhance productivity within general disciplines.

general-purpose computer system. A computer system that is not configured for a specific purpose but rather for a general application. This category includes supercomputers, minisupercomputers, parallel processor computers, mainframes, workstations, and the like.

general-purpose input/output (I/O) circuit. A circuit that permits a system to communicate via a wide variety of input/output (I/O) devices with the outside world, which can include printers, modems, and monitors.

general test equipment. Test equipment not included under the definition of automatic test equipment (ATE).

geographic information system (GIS). A mapping software application that contains the functions of cartographic software and also allows data analysis through Boolean operations on multiple data layers.

geophysical instrument. An instrument used to observe and measure the physics of the earth and its environment.

GIS. See **geographic information system.**

global positioning system. Equipment that calculates location based on one of several technologies such as radio or internal navigation.

golf ball. A type of print element invented by IBM for use in the IBM Selectric typewriter. It is a round, metal element with raised characters.

government. The organization, machinery, or agency through which a political unit exercises authority and performs functions and which is usually classified according to the power within it. Includes the executive, legislative, judicial, administrative, and regulatory functions.

graphic design art. A method of applied art used to form a visual end product that conveys information. Methods include drawing, painting, photography, printing, and bookmaking.

graphics. Software that permits the pictorial representation of information at a screen or printer. Early graphics packages showed bar charts or line graphs on a character-based terminal by placing characters such as + or * on grids created by repetitions of characters such as | and or _ . The term has come to apply usually to bit-mapped graphics, which are capable of processing images, freehand input, and icons on a pixel-by-pixel basis. Examples of graphics software include MacDraw and MacPaint.

graphics/animation/imaging. A software graphics application used by scientists and engineers to process and display complex technical data. It also includes applications that use computers to generate or manipulate graphics images that are the end product, i.e., cartoons.

graphics board. An add-on board connected to the bus that provides video capabilities for a personal computer.

graphics controller. A device that governs information flow used to create visual images of data.

graphics draw/paint. A software application that creates, retrieves, modifies, and prints graphic images.

graphics supercomputer. The performance of *mips*, *mflops*, *transforms per second*, and shaded polygons per second distinguishes graphics supercomputers from superworkstations. Performance ratings range from 20 to 40 mips and 16 to 40 mflops. The best distinction between graphics supercomputers and superworkstations is the graphics performance ratings, 100K to 600K 3-D vector transforms/second and 25K to 150K Gouraud-shaded polygons/second. The average price ranges from $75,000 to $150,000.

graphics terminal. A display terminal that provides graphical presentation of information to the operator. 1: Data conversion graphics terminals support the use of graphics to summarize or

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otherwise relate discrete data that were not originally graphics data. 2: Concept design graphics terminals support graphics displays that help realize accurate images of ideas conceived in the human mind. 3: Imaging graphics terminals display a real image, visible or nonvisible, that was digitized to allow enhancements or data extraction.

grinding programmable machine tool. A standalone machine with expanding use of computer numerical control (CNC) and with advance efforts to incorporate grinders into flexible, automated systems. Creep-feed is a type of grinding technology.

gross lease additions. The total volume of new equipment leases.

H

hand-held personal computer. The hand-held personal computer is a less-than-2-pound, fully functional personal computer. To be considered a hand-held personal computer, units must operate using a fully implemented version of MS-DOS and be able to run some of the shrink-wrapped MS-DOS-based applications. These units are expected to have a subsize keyboard and utilize nonstandard mass storage devices. The criterion for inclusion in this classification is that the device may be held in one hand using the other hand for data entry via the included keyboard. They are fully battery powered units.

hard disk. See **rigid disk.**

hard disk controller. A device that controls the storage and retrieval of data from a user's hard disk drive.

hardware. Electronic equipment, systems, or peripheral devices.

hardware maintenance service. Remedial repair services for equipment, systems, and peripherals. Hardware maintenance can include on-site support, telephone/remote support, preventive maintenance, and other activities necessary to maintain hardware operation.

HDTV. See **high-definition television.**

head; manganese-zinc, landable. A type of head used in sealed fixed-media drives where heads land on the lubricated media surface and use hot-pressed manganese-zinc pole pieces.

health care. An environment or industry that includes establishments primarily engaged in providing medical, surgical, and other health services.

helical scan tape drive. A storage tape drive that records data on an angle rather than parallel. Tape dimensions can be 4mm, 8mm, 13mm, or 19mm. Segments of this category are VHS, DAT, 8mm, and other. (See also **VHS, DAT.**)

high-definition television (HDTV). A television standard with high-resolution, digitized images; wide, theater-like screen; and digital stereo sound. Requires a broader video bandwidth to accommodate increased picture transmission.

higher education. Study beyond secondary school at an institution that offers programs terminating in an associate, baccalaureate, or higher degree.

high school. A secondary school offering the final years of high school work necessary for graduation, usually including grades 10, 11, and 12 or grades 9, 10, 11, and 12.

home. The usual place of residence. A home-based business is an enterprise producing goods or services that is operated in or from the home.

horizontal-turning programmable machine tool. The tool of a machine that holds a piece along the horizontal axis for a certain function to be performed such as cutting, boring, or drilling.

host/vendor independent terminal. A host-independent display terminal produced by an independent manufacturer. It may operate in either character or block mode. The independent manufacturer does not supply mainframes or minicomputers to which its display terminals may attach. Not included is any terminal that is from an independent manufacturer and that is protocol-specific to either a minicomputer-based or a non-IBM, protocol-specific terminal.

hotels and lodging. An environment or industry that includes commercial and noncommercial establishments engaged in furnishing lodging, or lodging and meals, and camping space and camping facilities.

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household. The set of persons occupying a housing unit. Thus, counts or estimates of households, householders, and occupied housing units are always defined the same.

hybrid. 1: Made up of several different components. 2: A hybrid integrated circuit is made by putting several integrated circuit die and/or passive components on a ceramic substrate with a metal pattern. 3: A substrate containing more than one component. The substrate consists of multiple ceramic layers and also can contain multiple packages. 4: A device in a speech transmission system consisting of transformers that convert a two-wire channel into a four-wire channel, thus creating a separate wire pair for each direction of transmission.

hybrid analog IC. An analog IC that combines one or more semiconductor chips with other technologies, such as chip capacitors and film resistors, on a single substrate.

hydrogen. A chemical element used for hydrofining for sulfuration of petroleum products or to reduce metallic oxide ores.

I

IBM 3270 protocol terminal. A terminal that is protocol-specific to IBM's 3270 Information Display System. Included is any IBM 3270-type terminal or 3270-compatible terminal produced by another manufacturer. A terminal that can provide the appearance of a 3270 device when used with a protocol converter is **not** included.

IBM/VM/MVS. An IBM standard multiuser operating system.

IC. See **integrated circuit.**

IC layout and verification. A software application tool that is used to create and validate physical implementations of an integrated circuit (IC). IC layout tools include polygon editors for creating geometric data, symbolic editors, placement and routing (gate array, cell, and block), and DRC/ERC verification tools.

IDVT. See **integrated voice/data workstation.**

if-sold revenue. The amount of money paid for products based on list price. List price does not take into account discounts or markups.

if-sold value. A measure that reflects unit shipments multiplied by list price.

IGBT. See **insulated gate bipolar transistor.**

illustration software. An object-oriented software program that allows the user to create original artwork consisting of lines, arcs, and other mathematically generated geometric objects. (Line art is a term sometimes used to describe the results of illustration software.) Some illustration software can perform raster-to-vector conversion by allowing users to trace over scanned raster art. This trace can occur on screen or on a graphics tablet. Illustration software usually offers raster-fill patterns that extend to cover an area in an illustration bounded by geometric objects.

image communication. Equipment used in a business or residence to transmit image and text. Facsimile equipment, video teleconferencing, telex, and videotex are included in this classification.

image-editing software. A software program that allows a user to modify existing artwork existing in raster format. This art may have been scanned or captured as analog signal data and converted to digital data. Image-editing software can handle binary data, in which case it is called print software; or it can handle grey-scale and/or color data, in which case it is called image-retouching software.

image generation. Synonymous with image synthesis and equivalent to the historical use of graphics.

image management. The process of directing, controlling, or handling something that closely resembles another.

image processing. A series of actions, changes, or functions that bring about a particular result for something that resembles another.

imaging. See **graphics/animation/imaging.**

imaging subsystem. A peripheral device that does not possess video display terminal (VDT) functionality, but acts as output devices for the display of graphics and/or image data.

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impact printer. A family of printers that use direct impression impact of a type bar, type head, or matrix pin to exert pressure against a paper ribbon and a platen to create a character.

import. The supply of products from a foreign country for the purpose of trade or sale.

in-circuit PCB tester. An equipment tester that incorporates pin electronics (drivers and receivers) that verify the functionality of each part on an assembled circuit board. Verifies each component's parameter and limited functionality.

indirect channel. A variety of distribution channels in which product is brought to the end user. It includes value-added resellers (VARs) and original equipment manufacturers (OEMs).

inductor. A passive component that stores energy in the form of a magnetic field (flux) around a core body.

industrial design. A process that integrates the design tools defining the style and functional aspects of the total design.

industrial electronic equipment. Electronic equipment used in a manufacturing environment or industry.

industrial marking. A specified format on media that is recognized by electronic or visual means. Examples are the printing and use of forms, bar codes, ticket printing (lottery and airline, for example), and labels.

industry. A collective term for many of the productive activities of a nation or other large group. A collective term in which a number of firms produce the same kind of commodity or service or are engaged in the same kind of operation.

INEWS. See **integrated electronic warfare system.**

information center. A center designed specifically for storing, processing, and removing information for dissemination at regular intervals, on demand or selectively, according to the user's needs.

information resource management. A program that works with definitions, uses, values, and distribution of information that is processed by a user and handled by a computer system.

infrared. Those radiations, such as are emitted by a hot body, with wavelengths just beyond the red end of the visible spectrum. Wavelengths longer than those of visible light and shorter than those of radio waves.

ink jet. An image-producing process currently used in electronic printers, plotters, and full-color copiers that uses piezoelectric technology to expel a very small droplet of liquid ink through nozzles onto the output paper.

ink jet printer. A nonimpact printing method that uses ink droplets to form a printed image. This technology usually is classified by the nature of the drop stream; two major categories are continuous flow and drop-on-demand.

input/output (I/O) device. 1: Equipment used to communicate with a computer. 2: A general term applied to equipment used in communicating with a computer and the data involved in the computer. 3: The transmission of information from an external source to a computer or vice versa.

input/output (I/O) ratio. 1: A ratio of the value of a resource input to the value of the final product output, typically expressed as a percentage. 2: A measure of throughput for a computer system.

inspection. The process of testing or measuring an object or process by remote sensing in imaging technology.

installed base. The total number of product in active, day-to-day use.

institutional support. In higher education, the expenditures that include day-to-day operational support for colleges, excluding expenditures for physical plant operations. Examples of institutional support include general administrative services; executive direction; planning, legal and fiscal operations; and community relations.

instruction. In higher education, expenditures of the colleges, schools, departments, and other instructional divisions of higher education institutions and expenditures for departmental research and public service that are not separately budgeted. Includes expenditures for both credit and noncredit activities. Excludes expenditures for academic administration where the primary function is administration.

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instructional. Products used to increase the understanding (either problem-solving or self-improvement) of a specific subject matter. The primary focus of these products is the imparting of knowledge or skills to the user.

instructional staff. In education, the number of full-time equivalent positions, not the number of different individuals occupying the positions during the school year.

instrumentation. Designing, manufacturing, and using instruments for detection, observation, measurement, automatic control, automatic computation, communication, or data processing.

insulated gate. A gate that is separated from other conducting surfaces through a nonconducting material.

insulated gate bipolar transistor (IGBT). A power transistor that has the insulated gate properties of a MOS transistor with the low saturation ON voltage of a bipolar transistor.

insurance. An environment or industry that covers carriers of all types of insurance and insurance agents and brokers.

integrated application. A software application that combines several functions into one software package, which may include word processing, database management, and spreadsheet capabilities but is not exclusive to these functions. Data must be able to be shared among these functions.

integrated circuit (IC). A combination of interconnected semiconductor elements inseparably associated on or within a continuous substrate. Complete module of components manufactured as single, solid units made by either a film deposition or a diffusion process.

integrated electronic warfare system (INEWS). A combination of interconnected circuit elements associated on or within a continuous substrate to produce integrated systems used specifically in military operations.

Integrated Services Digital Network (ISDN). A digital network having the capabilities of simultaneous signaling, switching, and transporting over a single facility. A new worldwide telephone standard that will make it easier to communicate information such as voice, data, and video over phone lines.

integrating and totalizing meter for gas and liquid. A meter that registers consumption and positive displacement, including meters, fuel dispenser meters, and gas meters.

integrated voice/data workstation (IDVT). Terminal that possesses both telecommunications and computational capability.

integration. Integration of data types can be achieved using page composition and pagination applications.

intelligent terminal. An interactive terminal in which part of the processing is accomplished by a small computer or processor contained in the terminal itself. This type of terminal is sometimes referred to as a smart interactive terminal. Such a terminal has the following characteristics: (1) self-contained storage; (2) user interaction—with the terminal or the central computer; (3) stored program; (4) part of processing accomplished in the terminal; (5) on-line via communications line with large central computer and database; (6) human-oriented input—such as keyboard and light pen; and (7) human-oriented output—such as serial printer and CRT.

interactive language. Within a system, a human user or device serviced by the computer can communicate directly with the operating program or language.

intercom systems. A system that provides internal communication, allowing calling to be confined to inside the system. In most cases, key systems provide the intercom lines that allow quick communication between stations on the key system.

interconnect and bare-board tester. Equipment designed to check, monitor, and identify printed circuit boards for electrical connectivity and detect manufacturing defects.

interface IC. An analog IC that is dedicated to interfacing digital information (in bits) with external nonsemiconductor devices such as displays, lines, solenoids, and other peripheral devices.

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internal transfer. The process of conveying or moving goods and services from the producer within a company.

international telephone service. Telecommunication services between offices or stations in different states or between mobile stations that are not in the same state or are subject to different states.

interrupt controller. 1: An internal controller chip that can break into the normal flow process of a routine such that the flow can be resumed from that point at a later specified time. 2: A condition or event that temporarily suspends normal processing operations. 3: A temporary disruption of the normal operation of a routine by a special signal from the computer. 4: Copying technology: A feature that allows a job to be stopped to allow another job to be run without the loss of programming for the first job.

intrusion-detection alarm system. A warning system used to detect when someone or something has intruded in a specified area. (See also **alarm system.**)

inventory. Items used in the process of manufacturing a product and distributing it to the end user. Inventory can be stored at a stock point or at a work-in-process location. Inventory may consist of finished goods, parts of intermediate items, work-in-process, or raw materials.

inventory and distribution management. An application that monitors the status of materials at all levels of production, including receipts, issues, and inventory balances. It identifies both unit quantities and dollar values and provides essential input to both the general ledger for cost accounting and the production planning modules.

I/O device. See **input/output device.**

ion implantation. The use of an ion beam to bombard a silicon wafer, altering the concentrations of p-type and n-type material. This method of doping allows for very precise control of the device parameters. This process introduces dopant atoms into the surface of silicon wafers and accelerates them so that they bombard the wafer, causing them to penetrate the exposed portions of the wafer.

ion milling. A technique in semiconductor manufacturing in which a beam of charged particles is used to remove material from a wafer.

I/O ratio. See **input/output ratio.**

IR. See **infrared.**

ISDN. See **Integrated Services Digital Network.**

IVR. See **interactive voice response system.**

J

joint venture. Two or more companies providing capital or other resources to invest or make available for investment in the ownership of a new enterprise.

K

keyboard. An input device that allows an operator to enter alphanumeric characters through a typewriter-style key arrangement augmented with special function keys—manual operation of keys will generate electrical signals or cause tape to be punched, or both.

keyboard controller. A device that governs the functions of a keyboard transmitting a command to do something within a system.

key entry equipment. Data entry equipment such as key disk, key tape, or keypunch equipment.

key telephone system. A customer premises telephone switching system that allows telephones to interface to the public telephone central exchange or office without using an access code. This category includes the electromechanical 1A2 and electronic segments.

L

label. 1: A set of symbols used to identify or describe an item, record, message, or file. May be the same as the address in storage. 2: Matter attached to a document to identify or provide information. 3: To assign a symbol, acronym, or word as a means of identification to create a specialized record or filing handle. 4: A

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descriptive or identifying word or phrase. 5: To address, using self-adhesive addressing labels.

laboratory. 1: A software application that involves the use of computers inside analytical instruments and in linking these instruments together (instrumentation automation). Mass spectrometers and blood/gas analyzers are examples. 2: A place equipped for experimental study in a science or for testing and analysis.

laboratory and scientific apparatus. Any instrument, material, or equipment designed for a specific operation or particular use in the laboratory.

LAN. See **local area network.**

LAN-based e-mail. A software application that enables users of a local area network (LAN) to send and receive textual data. Some LAN-based e-mail software can send and receive computer files and graphic images.

language. In software, a set of commands that permits the programmer to perform arithmetic functions on data and/or give commands to specific hardware components of the computer system, such as the printer, terminals, disk, or memory. Statements in languages are generally required to be performed in a fixed order, although the order may be affected by loops and branches in the program and the values of parameters that control the looping and branching. Examples of low-level languages are C and assembler; high-level, or third-generation, languages include FORTRAN, COBOL, BASIC, and PL/1.

language editor. A set of computer commands forming code to edit files. May involve deleting undesired information, selecting desired information, inserting invariant symbols, and applying standard processes.

laptop A/C. The laptop A/C units reflect the standard laptop design, i.e., clamshell-style case with the display mounted in the top portion of the shell and covering the keyboard until the unit is opened for use. These units, like transportables, are designed to be easily moved from place to place but operate only on A/C power and do not contain batteries of any kind.

laptop D/C. The laptop D/C units are identical in style to the laptop A/C units except that they are powered by batteries and can be operated without direct connection to A/C power lines. Some of these laptop D/C units have a combination of battery- and A/C-power capability.

laptop personal computer. The laptop-case style is conducive to operation on the user's lap and is designed to be used in areas where space is restricted. This case style is referred to as the clamshell-type of system, with the display screen mounted in the top of the unit in such a way as to cover the keyboard when closed and be at the proper viewing angle in relationship to the keyboard when opened and ready for operation. This unit is completely self-contained and can be carried as a single unit that includes the keyboard, display, mass storage, and main system unit.

large-format plotter. This plotter uses media engineering size C (17 x 22 inches) or larger and corresponding metric sizes. (See also **plotter.**)

laser (light amplification by stimulated emission of radiation). 1: A device that transmits an extremely narrow and coherent beam of electromagnetic energy in the visible light spectrum. 2: A laser that operates at optical frequencies. In communications, lasers may be amplitude-modulated and used to carry speech information that is received by a light beam detector.

laser diode. A laser diode is a laser that is constructed with a semiconductor material. Many III-V semiconducting materials can be made to emit coherent light, creating a laser.

laser plotter. A device that produces an inscribed visual display of the variation of dependent variable as a function of one or more variables by the use of intense coherent beams of light.

laser printer. A type of nonimpact printer that combines laser beams and electrophotographic technology to form images on paper.

laser system. Any electronic device or system that is actuated by beams of coherent visible and infrared light to accomplish a task.

LCD. See **liquid crystal display.**

learning. An application that assists the user in learning. The subject can range from classic school subjects to games, art, and languages.

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lease. A contract by which one conveys equipment, facilities, or property for terms specified.

lease accounting. An application that supports the management of leases.

leased circuit. A service offering that provides a customer with permanent (rather than dialed) connections to all points on the circuit for the duration of a contract.

lease/rental conversion. The volume of contractual conversions between rental and lease options.

LED. See **light-emitting diode.**

library management. A software application that supports the administration of a library, including cataloging.

LIDM. See **line, impact, dot matrix.**

LIFF. See **line, impact, fully formed.**

light communication system. Electromagnetic radiation of a wavelength originating at one place and reproduced at a distant point.

light-emitting diode (LED). A pinhead-size device with a pn junction formed from combinations of gallium, arsenic, and phosphorus. Light emission is the result of hole-electron recombinations that take place near the junction of the p-doped and n-doped regions. As the electrons in the n region of the diode travel through the area near the junction, they recombine with a hole. As a result of this recombination between an electron and atom, light in the form of photons is produced. The wavelength of color of the light is determined by the energy level.

light-emitting display. Light-emitting diodes grouped together in a matrix of dots to form characters.

linear array/ASIC. An ASIC that is purely analog.

linear IC. An IC that is purely analog; both inputs and outputs are analog signals. Sometimes, linear and analog ICs are used interchangeably. Dataquest uses linear as an analog-only segment of the analog market (mixed signal analog/digital is the other segment).

line conditioner. Equipment that changes/enhances the transmission characteristics of a circuit.

line, impact, dot matrix (LIDM). A printer that prints one line of dots at a time using an array of elements in a printhead.

line, impact, fully formed (LIFF). A printer that creates one line of characters at a time by placing characters—from a band, type train, or drum—on the paper by the pressure of an impact mechanism (hammer).

line, nonimpact, thermal transfer (LNTT). A printer that prints a line at a time, using an electrically heated element to produce images.

line printer. A printer that usually prints one line at a time at a higher speed than a character printer. Typical line printers use a drum, chain, or train of print elements and have a hammer for each print position in the line. They usually have a buffer to hold one print line. Line printers are segmented by technology (dot matrix, fully formed, thermal) and by speed, expressed in lines per minute (lpm).

linkage mechanism. An assembly of components, with two or more movable parts usually providing some means of power, control, or fastening application.

liquid crystal display (LCD). A high-contrast, black-on-white display screen that uses closely spaced crystal segments on a square dot matrix. The crystal segments butt together to form solid characters. A liquid crystal hermetically sealed between two glass plates.

list price. The price of a product as indicated in the seller's price book. This figure is usually quantity one and is synonymous with manufacturer's suggested retail price.

lithography. 1: A printing process that prints from a planographic image on a printing plate. Lithographic presses are configured as sheetfed and web presses, depending on the format of the paper used. 2: A technique used in semiconductor manufacturing in which a silicon wafer is coated uniformly with a radiation-sensitive film (the resist) and an exposing source illuminates selected areas of the wafer's surface through a mask or template for a particular design.

LNTT. See **line, nonimpact, thermal transfer.**

local area network (LAN). The hardware, software, and peripherals that enable connection of a device to a cable-based network system that

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serves a building or a campus environment. Excluded are connections that are point-to-point, or go through PBXs or data PBXs. Ethernet and Token-Ring are popular LAN technologies.

local government. The political unit or organization governing counties, municipalities, townships, school districts, and numerous kinds of special districts.

local loop. The portion of the telecommunications system that connects the customer's equipment with the local telephone company's network.

local telephone service. A service that includes message telecommunications services, private line services, wide-area telecommunications services (WATS), and centrex services.

logic circuit. 1: A circuit (usually electronic) that provides an input-output relationship corresponding to a Boolean-algebra logic function. 2: An electronic device or devices used to govern a particular sequence of operations in a given system. 3: Circuits that perform basic logic decisions *and/or/not,* used widely for arithmetic and computing functions. Circuits can be of either bipolar or MOS technology.

long distance telephone service. The revenue generated by all long distance carriers for interstate and intrastate long distance telephone services.

M

machining-center programmable machining tool. A machine that is designed to fabricate a complete or near complete part of a single machine, with machining centers that perform a number of different operations in a single setup.

machining robot system. A robot that can pick up parts and place them in a new location. Parts are usually moved in and out of machinery or transferred from station to station.

mag card/mag tape. A tape or card that is coated or impregnated with magnetic material, on which information may be stored in the form of coded polarized spots.

magnetic. The effects of magnetism/flux on the system.

magnetic disk. 1: A random-access storage device consisting of magnetically coated disks accessible to a reading and writing arm, similar to an automatic record player. Data are stored on the surface of each disk as small, magnetized spots arranged in circular tracks around the disk. The arm is moved mechanically to the desired disk and then to the desired track on that disk. 2: A flat, circular plate with a magnetic surface on which data can be stored by selective magnetization of portions of the flat surface.

magnetic ink recognition. Property of automatic devices that can detect or read ink-containing particles of magnetic substance, i.e., the ink used for printing on some bank checks for magnetic ink character recognition (MICR).

magnetic media. Any of a wide variety of belts, cards, disks, or tapes (as contrasted with paper tape) coated or impregnated with magnetic material for use with the appropriate equipment and on which dictation or keystrokes can be recorded and stored.

magnetic recording head. A magnetic head that transforms electric variations into magnetic variations for storage on a magnetic medium such as tape or disk.

magnetic resonance imaging. Equipment used on an object placed in a spatially varying magnetic field that is subjected to pulses of radiation; the resulting nuclear magnetic resonance spectra are combined to give cross-sectional images.

magnetic tape. A serial-access magnetic storage medium. Typically, a flat ribbon of metal, plastic, or paper that is coated on one side with material that can be magnetized; information is stored on the tape by a combination of magnetized spots in certain patterns. (See also **magnetic media.**)

mailing/letter-handling/addressing equipment. Mailing systems and equipment that have been automated with components to increase capabilities and to streamline efficiencies.

mail order. A sales method by which a consumer may order products through a catalog.

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main distribution frame (MDF). A unit used in telephone wiring for terminating and cross-connecting telephone wiring to the telephone-switching system. The MDF is the primary (or first) distribution point. (See also **distribution frame.**)

mainframe computer. A general-purpose information system with price range of $350,000 and up. CPU bit width ranges from 32 to 64 bits. Physical environment can be either with or without special environmental controls and requires full-time support by professional computer systems support staff with 10 or more members. Number of concurrent users is 250 or more.

maintenance management. The upkeep of property, equipment, or tooling through planning, analysis, and documentation of maintenance functions.

management. An application that supports the management of data that can be achieved using document image management software and systems.

manufacturer. A producer or assembler of goods.

manufacturer's representative/agent. An independent contractor who represents multiple manufacturers. She or he does not take title to the product.

manufacturer's suggested retail price. See **list price.**

manufacturing automation. The use of a computer to aid and improve a manufacturing process.

manufacturing EATE N.E.C. Equipment that tests electronic systems that are composed of a number of subsystems. The testing equipment must verify operability and be capable of locating a faulty subsystem or component in event of failure.

manufacturing engineering tools. The small segment of manufacturing engineering that is concerned with tool and fixture design and the development of manufacturing processes.

manufacturing system. A system used to process raw material into a finished product.

mapping. Computer-aided tools that allow geographically related data to be captured, edited, analyzed, and managed. Typical users are civil and utility engineers, geophysicists, and geologists.

market. The demand for a product or service.

market share. A comparison of a company's performance with the total market so that its relative position and the amount of the market it captured is derived.

markup. 1: The amount added to the cost to determine the selling price for a specific product. 2: The amount added to the cost to determine the selling price for a specific product.

maskmaking e-beam. Semiconductor production equipment utilizing a method that allows submicron pattern generation for producing semiconductor mask plates or maskless lithography. (See also **lithography.**)

mask ROM. A semiconductor read-only memory programmed to the customer's specified pattern during the manufacturing process. (See **read-only memory.**)

mass merchandiser. A segment of the distribution channel with storefront locations. It differs from a dealer in that its primary business is the sale of a broad range of consumer goods.

mass property. The analysis of the physical characteristics of a part, assembly, or system. The evaluation of multiple properties—measures volume, weight, and surface area and locates center of gravity.

mass storage peripheral. A device that interfaces with the system or machine to external memory storage.

material. The designation of a number of basic metals, compounds, and gases to make up thermoelectric materials.

material-handling equipment and systems. Equipment such as 1: Movement—Automated guided vehicle systems, conveyors, and monorails;

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cranes and lift trucks are included only when they are computer-controlled; material-handling robots are included in Robotics in Manufacturing. 2: Storage—Automated storage and retrieval systems; miniload, microload, and carousels. 3: Identification—Bar codes, radio frequency, machine vision, and other sensors used for identification are covered in Sensors in Manufacturing. 4: Controls—Computers, programmable controllers, and software used in material handling are included in Computers in Manufacturing and Software in Manufacturing.

material-handling/loading robot systems. Robotics used in the loading, moving, storage, and unloading of materials.

material requirement planning (MRP). A planning method that uses bills of material, inventory data, and a master production schedule to calculate material requirements. This method makes recommendations to restock materials inventory. Further, because material requirements planning is time-phased, this method makes recommendations to reschedule open orders when due dates and need dates are not in phase. Originally seen only as a better way to order inventory, material requirements planning is thought of today primarily as a scheduling technique, i.e., a method to establish and maintain valid due dates on orders.

matrix printer. An impact printer that uses wire, hammer-like bristles, or needles to create characters formed by small dots. Matrix printers produce either serial or line output. The serial printer employs a moving printhead with a matrix block (i.e., 5 x 7 or 7 x 9) of needles. The printhead sweeps across the page to print full characters one at a time. The line printer uses a horizontal band with raised dots that moves from left to right across the paper. The individual needles strike programmed character dots to form one row of dots per sweep across the page. Successive passes of the line printer form complete characters and complete rows of textual data. High-resolution text, comparable to daisywheel output, may be produced by overlapping matrix printers that print characters via a highly concentrated matrix or successive, staggered passes of the printhead. Fonts for matrix printers are stored in ROM or PROM memory.

MBE. See **molecular beam epitaxy deposition.**

MCAE. See **mechanical computer-aided engineering.**

MCU. See **microcontroller.**

MDF. See **main distribution frame.**

mechanical. Mechanical CAD/CAM is the software application of computer-aided tools to design, analyze, document, and manufacture discrete parts, components, and assemblies.

mechanical assembly equipment. 1: Machinery or equipment that assembles mechanical parts into subassemblies or final products. 2: Dial or rotary assembly machines; in-line transfer machines; flexible assembly equipment (except robots).

mechanical computer-aided engineering (MCAE). The application of CAD/CAM tools for mechanical design and analysis. MCAE applications range from conceptual product design through detailed product design and analysis to supporting production design. Commonly used MCAE products are solid modeling and finite element analysis technology.

mechanical computer-aided manufacturing. See **mechanical.**

media-to-media data conversion equipment. Computer output-to-microfilm recording units, tape print units, card-to-tape conversion units, as well as document entry devices.

medical. An environment or industry that uses computers to control and/or collect and analyze data from patients, medical equipment, and/or instruments.

memory. 1: A device into which data can be entered and stored for later retrieval. 2: An integrated current (IC) designed for the storage and retrieval of information in binary form; can be either bipolar or MOS technology and includes dynamic random-access memory (DRAM), static random-access memory (SRAM), read-only memory (ROM), programmable read-only memory (PROM), erasable programmable read-only memory (EPROM), and electrically erasable programmable read-only memory (EEPROM).

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memory management unit (MMU). 1: An integrated circuit that manages the storage and retrieval of data found by cell location or address. 2: A component (or set of components) that implements the memory management function in a processor-based system.

merchant production. The sale of a good to a company other than the manufacturing company.

merger and acquisition. In financial terms, it means to absorb or acquire one company by another.

metalorganic CVD (MOCVD). A technique used to deposit material onto a wafer.

metal oxide silicon (MOS). 1: A circuit in which the active region is a metal oxide semiconductor sandwich. The oxide acts as the dielectric insulator between the metal and the semiconductor. 2: A process that results in a structure of metal over silicon oxide over silicon. 3: Technology that employs field effect transistors having a metal or conductive electrode that is insulated from the semiconductor material by an oxide layer of the substrate material.

meteorological instrument. An instrument used to monitor and observe the weather.

metropolitan statistical area. A large population nucleus, together with adjacent communities, that has a high degree of economic and social integration with that nucleus. Each metropolitan statistical area (MSA) must include at least: (a) one city with 50,000 or more inhabitants, or (b) a census bureau-defined urbanized area of at least 50,000 inhabitants and a total MSA population of at least 100,000 (75,000 in New England).

microcomponent. 1: An integrated circuit (IC) with high-speed, low-power density considered as a single part. 2: An IC that contains a processing unit or acts as an interface chip to such a device. Types of microdevices include microprocessor (MPU), microcontroller (MCU), microperipheral (MPR), and digital signal processor (DSP).

microcomputer. An information system with price ranging up to $100,000, with the majority priced at less than $50,000. CPU bit width is normally 32 bits, but can be as low as 8 bits. Traditionally used as a desk-side or desktop system configuration. Normally a multiuser system used in a common work area. Usually has a merchant (nonproprietary) microprocessor.

microcontroller (MCU). An integrated circuit, containing a CPU, memory, and I/O capability, that can perform the basic functions of a computer.

microperipheral (MPR). A support device or circuit for a microprocessor or microcontroller that either interfaces with external equipment or provides system support.

microprocessor (MPU). A single-chip component, or a collection of architecturally interdependent components, functioning as the central processing unit (CPU) in a system. A microprocessor may contain some input/output circuits, but it usually does not operate in a standalone environment.

microprogrammable digital signal processor (MPDSP). An integrated circuit that allows high-performance, modular DSP architectures to be designed using standard off-the-shelf components. Products include bit-slice and building block components.

microwave. 1: Any radio wave with a frequency higher than 890 MHz or a wavelength of between 1ml and 1m. 2: A form of electromagnetic radiation that has frequencies of 1 GHz. These high-frequency bands of energy are used extensively for radar and wideband communications.

microwave antenna. A device used for receiving and transmitting microwave signal beams. (See also **antenna.**)

microwave monolithic integrated circuit (MMIC). An electronic circuit employing monolithic integrated circuit technology fabricated by microelectronic techniques and capable of operating at frequencies above 1 GHz.

microwave oven. An oven that uses electron waves to produce heat for faster cooking of foods.

microwave radio equipment. Equipment that includes transmitter/receiver systems, power supplies, repeaters, and other equipment used in microwave radio systems. It also includes analog and digital equipment used both in common carrier and in private industrial systems.

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midrange. The combination of microcomputer, minicomputer, and superminicomputer.

military/aerospace electronic equipment. Electronic equipment used in the military and civilian aerospace industries.

military communication equipment. Voice, data, and cryptographic equipment used for communication in the military.

military computer system. A computer system used for military purposes; a set of hardware components that form a system intended solely for military applications. This category includes general-purpose CPUs, storage, input/output, and terminals and includes both commercial, ruggedized, and mil'spec versions for integration into military systems and for government-sponsored programs.

military electronic equipment. Electronic equipment used exclusively by the military. Usually, this equipment must meet government specifications and regulations.

military simulation and training. The performance of military maneuvers/exercises as training for real-life military situations. This category includes flight and battle simulators and equipment operation and maintenance systems.

milling programmable machine tool. A machine tool for the removal of metal by feeding a workpiece through the periphery to remove the material through the motion of workpiece and cutter.

minicomputer. An information system with prices ranging from $10,000 to $300,000 but mainly falling between $25,000 and $150,000. CPU bit width ranges from 8 to 16. Minicomputers are situated usually in a common work area and occupy more floor space than most tower configurations. Number of concurrent users ranges from 15 to 100. System usually incorporates proprietary processor, with notable exceptions, and is often packaged with third-party application software and/or peripherals and then resold into specialized applications or vertical markets. Examples of models are the HP 1000, HP 3000/70, PDP-11/84, and IBM Series/1.

minicomputer-based terminal. A display terminal provided by a minicomputer manufacturer or a display terminal that is protocol-specific to an IBM System/34, /36, or /38 computer. This terminal may operate in either character or block mode. Excluded from this category is any minicomputer-compatible terminal supplied by an independent manufacturer.

miscellaneous military equipment. Equipment that includes classified systems, test equipment (N.E.C.), vehicle control, medical equipment, assorted development and office equipment, and research and development equipment; all used in the military.

mixed signal ASIC. An ASIC that has one analog input or output and one digital input or output.

mixed signal IC. An integrated circuit that has one analog input or output and one digital input or output.

MMIC. See **microwave monolithic integrated circuit.**

MMU. See **memory management unit.**

mobile communications equipment. Equipment (base stations, mobile units, and antenna) used primarily for portable public or private communications.

mobile infrastructure. The central base station and other central equipment that provide mobile communication services.

mobile radio base station equipment. The base/centralized station equipment associated with cellular radio systems. This category includes both switching equipment and radio transmitter/receiver equipment.

mobile radio service. Service or network revenue associated with cellular radio systems. (See also **mobile service.**)

mobile radio system equipment. Electronic equipment used in the transmission and receiving of radio signals. Equipment includes main central control, base control mobile stations, and handheld car units. Used primarily with cellular and other mobile communication technologies.

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mobile service. Radio service between a fixed location and one or more mobile radio stations, or between mobile stations.

mobile telephone service (MTS). Radio communication between a mobile (portable) unit and the public switched network including cellular service.

modeling. An application that supports the representation of a process or system by using equations that simulate and represent behavior under varying conditions.

modem. 1: An electronic device that provides modulation and demodulation functions of transmitted data signals over telephone lines. They convert digital data signals to analog for transmission over leased lines or the analog public switched telephone network. 2: The integrated circuits used in a modem.

molecular beam epitaxy deposition (MBE). A technique used in semiconductor manufacturing to deposit a single crystal layer on a substrate by use of a molecular beam.

molecular engineering. See **computational chemistry/molecular engineering.**

money management. An application that identifies and controls the source, flow, location, and earning potential of an organization's cash and investments.

monitor. 1: To check the operation and performance of a system or circuit by examining parts of transmissions. 2: The physical CRT unit, associated electronics, and housing used in display systems. 3: A station or equipment arranged to supervise system operation. 4: To supervise and verify the correct operation of a system, device, or program. 5: The screen of a video display terminal. 6: An analog monitor can display an almost infinite number of colors, while a digital monitor can display a more limited range of colors.

monolithic analog integrated circuit. An analog IC constructed from a single piece of material. All circuit components are manufactured in or on top of a single crystal of semiconductor material.

MOS. See **metal oxide silicon.**

MOS application-specific IC. See **application-specific integrated circuit.**

MOS cell-based IC. See **cell-based integrated circuit.**

MOS custom IC. See **custom integrated circuit.**

MOS digital. A semiconductor technology in which the active devices are n-channel, p-channel, or complementary MOS transistors that operate in a digital or binary mode. (See also **digital.**)

MOS FPGA. See **field-programmable gate array.**

MOS gate array. See **gate array.**

MOS logic. See **logic circuit.**

MOS memory. See **memory.**

MOS microcomponent. See **microcomponent.**

MOS microcontroller. See **microcontroller.**

MOS microperipheral. See **microperipheral.**

MOS microprocessor. See **microprocessor.**

MOS nonvolatile memory. See **nonvolatile memory.**

MOS PLA. See **programmable logic array.**

MOS PLD. See **programmable logic device.**

MOS PMD. See **programmable multilevel logic device.**

MOS standard logic. See **standard logic.**

MOS transistor. A field-effect transistor (FET) with a gate that is insulated from the semiconductor substrate by a thin layer of silicon dioxide. Being field-effect transistors, MOS-FET provide a voltage-input-to-current-output relationship called transconductance. MOS-FET are excellent switches because voltage at the gate turns the output current on or off.

mouse. A hand-held device that is moved on a surface to provide coordinate input to a graphics system. It is used most often to position a pointer or cursor.

MPDSP. See **microprogrammable digital signal processing.**

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MPR. See **microperipheral.**

MPU. See **microprocessor.**

MPU load programmer. A device that allows engineers and IC designers to program a variety of programmable devices (ICs), thereby speeding up the design process. The device to be programmed is loaded directly on the device programmer.

MTS. See **mobile telephone service.**

multilingual publishing. A system with the purpose/use of printing in a variety of languages.

multimedia. A process that uses more than one form of communication.

multiplexer equipment. Public telecommunication equipment used to combine a number of channels for transmission over a common medium, such as satellite, microwave radio, cable carrier, or fiber-optic cable. Excluded from this are data-only customer premises multiplex equipment and multiplex equipment that is integral to carrier or microwave radio systems.

multistrike ribbon. A ribbon that advances only part of a character width; characters slightly overlay one another on the ribbon, but no character hits the exact same spot on the ribbon.

multiuser system. A computer system inherently designed for environments with multiple users.

N

natural resources and construction. An environment or industry that includes establishments primarily engaged in agricultural production, forestry, commercial fishing, hunting and trapping, and related services; and mining or quarrying, developing mines, or exploring for nonmetallic minerals except fuel. Also, certain well and brine operations and primary preparation plants, such as those engaged in crushing, grinding, washing, or other methods of concentration.

navigation, military. A process for directing ships, aircraft, spacecraft, and other crafts to a specific destination. Equipment determines position, distance, and course of vessel or craft.

n-channel metal oxide semiconductor (NMOS). Pertaining to MOS devices made on p-type silicon substrates in which the active carriers are electrons that flow between n-type source and drain contacts. The opposite of PMOS. NMOS is two to three times faster than PMOS. (See also MOS.)

net additions. 1: The change in stock, such as installed base or inventory. 2: The relative increase or decrease in the total installed base of a product.

NETVIEW. IBM network management product.

network management. A software application that controls the logical connections and information flow among computers on a network. This software may have additional functions such as performance measurement and diagnostic and accounting functions.

network support services. All services that help customers better utilize their networking facilities. The services include site planning, installation, and ongoing on-site and remote maintenance support, as well as professional services such as network design/planning, integration, administration, and operations management.

network terminating devices. Equipment that connects a data network to the data terminal.

new placement demand. The total end-user demand for new products (as compared with replacement products).

newspaper publishing. A system with the main purpose/use of printing newspapers; typically daily or weekly publication containing such elements as news, feature articles, and advertising.

nitrogen. A chemical element.

NMOS. See **n-channel metal oxide semiconductor.**

non-IBM, protocol-specific terminal. A terminal that is protocol-specific to a Burroughs, Honeywell, or Sperry mainframe computer. Included is any terminal of this type that connects to another computer by means of protocol emulation.

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nonimpact printer. A hard-copy computer output device that forms images through electrostatic or other nonimpact methods. These printers include ink jet, laser, and thermal printers. (See also **ink jet printer.**)

nonvolatile memory. An integrated circuit using two-junction transistor technology where memory retains information when the power is off. Also known as core or permanent memory. Can be either bipolar or MOS technology process.

nonvolatile random-access memory (NVRAM). A read/write semiconductor memory device that does not lose information when the power is turned off.

notebook personal computer. The notebook personal computer is a system that resembles a laptop personal computer in general form factor and appearance. This personal computer is smaller and lighter in weight than a laptop D/C unit. The "standard" notebook size is 8.5 inches by 11 inches by 2 inches or less, and the weight of these units is in the 5- to 7-pound range. Notebook computers also, presently, make use of industry-storage mass storage media including 3.5-inch floppy disk.

nuclear radiation detection and monitoring instrument. An instrument used to detect, inspect, monitor, and control alpha particles (neutrons, protons, and electrons) that emanate from the atomic nucleus as a result of radioactivity and nuclear actions.

numerical control. 1: Computer instructions that automate machining and drafting tools. 2: A technique of simulating the operation of a machine tool. 3: Descriptive of systems in which digital computers are used for the control of operations, particularly of automatic machines. A technique of controlling a machine or process through the use of command instructions in coded numerical form.

numerical-control (NC) part programming. The programming of a numerical-control machine tool or automated processing system. Graphics and language-based programming tools are available.

NVRAM. See **nonvolatile random-access memory.**

O

OCR. See **optical character reader.**

OEM. See **original equipment manufacturer.**

office equipment. Equipment used in a business or office environment. Equipment may include copiers and duplicators, electronic calculators, dictating machines, electronic typewriters, word processors, banking systems, cash registers, and mail- and letter-handling equipment.

off-line robotics programming. A special-purpose process simulation that graphically represents the sequence of steps to program a robot for a particular operation. The resulting data can be downloaded to a robot to update its control program.

oil field services. A software application that uses small computers in the oil rigs or the wellhead areas to log and analyze data from sensors in the well.

OLTP. See **on-line transaction processing.**

one-time programmable read-only memory (OTP ROM). An EPROM packaged in plastic without a quartz window for erasure. Such a device is therefore programmable only once.

on-line transaction processing (OLTP). The input, tracking, and output of a well-defined record of information, processed in real time rather than batch. Examples include ATMs and airline reservations systems. OLTP systems are usually large and complicated enough that each one is customized, so there are few generic OLTP products. The RAMP-C and Debit-Credit benchmarks are examples of OLTP standards.

op amp. See **operational amplifier.**

open systems interconnection (OSI). A communication standard for network architecture that allows communication between various equipment.

operating environment. A set of conventions for screen appearance, keyboard, mouse and screen operations, and program functions. Operating environments function within an operating system.

operating system. 1: The software program in a computer that maps logical constructs to physical locations in the computer. The operating system is the program that lets a user access data by a file

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name without knowing where the file is physically located on the disk. 2: The operating system controls the computer's operations by managing disk, screen, file maintenance, and printer activity, while loading and running application programs.

operating utilities. A program or routine of general usefulness and applicable to many jobs or purposes.

operational amplifier (op amp). A type of integrated circuit (IC) that generates an amplified output that is exactly proportional to its input.

operator support system. Special equipment and/or software that facilitates the operation of a switchboard or comparable equipment.

optical CD/wafer inspection. Critical dimension (CD) refers to the line, element, or feature that must be manufactured and controlled to stringent specifications. Wafer inspection refers to the inspection of a patterned wafer for process defects by visual image process techniques.

optical character reader (OCR). 1: A device or scanner that can read printed or typed characters and convert them into a digital signal for input into a data or word processor. 2: The machine identification of printed characters through the use of light-sensitive devices; computer-input-only hardware.

optical disk controller. A device that controls the storage and retrieval of data from a video disk that is sensed through a laser beam.

optical disk drive. A data storage device utilizing laser technology. Types include CD-ROM, WORM, and erasable optical disk drives.

optical jukebox. A library system that holds multiple disk drives and optical disks to create a large storage environment on optical media.

optical media. The substance on which data are stored electronically and read by laser technology.

optical-scanning equipment. See **optical character reader.**

opto. See **optoelectronic.**

optocoupler. 1: A device that transmits electrical signals, without electrical connection, between a light source and a receiver. Also called an optoisolator. 2: A device that consists of an LED separated from a photo detector by a transparent, insulating, dielectric layer, all mounted in an opaque package. A current pulse in the LED causes a radiation pulse to flow across the dielectric layers to a photo detector, which produces a current pulse at the output. The input and output circuits are coupled with high-standoff voltage isolation.

optoelectronic (opto). A semiconductor device in which photons cause electron flow or vice versa. Optoelectronic chips contain transducers used between photonic circuit media and electronic media; they also may contain amplifiers, logic functions, and/or other photonic or electronic functions.

order entry and sales support. An application to support the process of accepting and translating what a customer wants into terms used by the manufacturer. This can be as simple as creating shipping documents for a finished goods product line to a more complicated series of activities including engineering effort for make-to-order products.

order entry/processing. Acceptance and translation of customer requirements into terms used by a manufacturer.

organization operation. A software application that supports the day-to-day running of an organization.

original equipment manufacturer (OEM). 1: An OEM may manufacture a product for assembly into another system or larger configuration by another manufacturer or vendor. 2: A purchaser of materials, components, or equipment to be incorporated into its product line. 3: A product reseller that integrates hardware, software, and/or services. The reseller may or may not own the hardware or software. An OEM differs from a VAR in that it adds its own label to the product and backs up its warranties.

OSI. See **open systems interconnection.**

OS/2. Computer systems based on the Intel 80XXX architecture and using OS/2 operating system software.

other. A subject or segment that is not distinctly defined within the Dataquest High-Technology Segmentation scheme.

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OTP ROM. See **one-time programmable read-only memory.**

P

PABX. See **private automatic branch exchange.**

pacemaker. An electronically pulsed oscillator implanted in the body to deliver electric pulses to the heart at a fixed rate in response to a sensor that detects when a person's heart rate slows.

packet assembler/disassembler (PADS). A system element that buffers data sent to and from character-mode devices and assembles and disassembles the packets needed for X.25 operation.

packet data switching. Data network switches that connect terminals and packet assemblers/disassemblers to a pre-edit node using a high-speed link (56,000 bps). Can be public or private.

PADS. See **packet assembler/disassembler.**

page composition. Refers to the page composition software used to produce finished draft or camera-ready pages whereby text and graphics have been aesthetically laid out using an editable WYSIWYG display environment.

page, nonimpact, plain paper (PNPP). A printer with the ability to buffer, in part or in whole, a page of images received from an electronic source and then to transfer these images to a receiving substrate.

page printer. A printer that prints characters one at a time to full-page format. Page printers are rated by speed categories, expressed in pages per minute (ppm).

paging equipment. Communication equipment that produces an audio signal in a radio receiver carried by an individual to tell him that he is needed at the telephone. Communication system for summoning individuals or making public announcements.

paging system. The equipment necessary to selectively alert individuals by tone or voice paging, either by pocket radio receivers or speakers within a building.

painting robot system. A system consisting of a number of robots programmed to paint by carrying spray guns and applying a coating of material. Also known as finishing robot.

PAL. See **programmable array logic.**

panel-type instrument. 1: Switches, dials, and buttons that are mounted on an electronic unit that controls and monitors a system. 2: Electronic instrumentation devices mounted on a panel for a variety of equipment purposes.

paper. Sheets of fiber formed on a fine screen from a water suspension. There are hundreds of different types of paper based on weight, brightness, color, opacity, and coating.

particle accelerator. A device that accelerates electrically charged particles (protons, electrons) to high energies.

part process design. The design of the actual manufacturing process and sequence.

parts service. Spare hardware modules or components used in the repair and/or replacement of failed hardware units.

passive device. 1: An inert component that may control, but does not create or amplify, energy. 2: A device that exhibits no transistance. A component that does not provide rectification, amplification, or switching but reacts to voltage and current. 3: Pertaining to a general class of device that operates as signal power alone.

patient monitoring. Equipment used to monitor, control, and record data on activity concerning or affecting a patient's health.

pay phones. A telephone instrument located in a public location that accepts coins for operation.

payroll. A software application that supports an organization making payment to its employees for work performed.

PBX-private branch exchange. See **PBX telephone system.**

PBX telephone system. A telephone switching system on the customer premises that, by dialing an access code, permits a telephone to interface to the public telephone central exchange or office.

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PC. See **personal computer system.**

PCB layout. Products that are used to create the layout of the traces and components to be placed on a printed circuit board.

p-channel metal oxide semiconductor (PMOS). An MOS device made on an n-type silicon substrate in which the active carriers are holes (p) flowing between p-type source and drain controls.

PC logic chipset. A semiconductor device (or set of devices) that integrates standard logic and controller functions onto a very large scale integration (VLSI) chip, resulting in a reduced component count on the PC motherboard.

PCN. See **personal communications network.**

pen-based personal computer. This is a new classification of portable computers for 1991. The general identifier for this class of machines is that they utilize a pen or stylus for data input and do not normally require a keyboard to operate. (Keyboard options are included in some of these models, but the system can be fully utilized without the inclusion of a keyboard.) Pen-based computers do not have to be able to run MS-DOS or applications that run under DOS. It is expected that there will be three or more operating systems utilized in this product: PenPoint by GO Corporation, Pen Windows by Microsoft, and others that have not been made public at the time of publication.

percent retirement. See **retirement.**

periodical publishing. A system with the main purpose/use of printing publications issued at intervals.

peripheral device. 1: Any instrument, device, or machine that enables a computer to communicate with the outside world, or areas in the operation of the computer. 2: Equipment that is connected to a computer but is not part of the computer. Examples include printers, terminals, and disk drives.

peripheral I/O management. 1: A program that interacts with the central processing unit (CPU) of a computer to communicate with devices beyond the CPU. The program interprets and responds to instructions from the CPU. 2: Information flows between the CPU and a unit of peripheral equipment.

personal communications network (PCN). A class of communications technology that allows communication with a mobile entity. Sample technologies include mobile radio, cellular, and paging services.

personal computer operating system. A personal computer operating system is a program that supervises and controls the operation of a personal computer.

personal computer system. A personal computer intended for use on the user's desk or work surface and not designed to be readily moved from place to place. Personal computers are those systems that include, as part of the basic system, a BIOS- or ROM-based software code that is designed to permit the use of the system with any of the existing personal computer operating systems.

personal electronics. Electronic equipment for personal use.

personal finance. A software application that records, processes, and reports on personal financial data, including personal banking, credit card management, and budgeting. These applications are suitable for small businesses as well as home use.

personnel management. A software application that supports an organization in managing its employees; may include many subapplications.

photoblank. A blank glass plate that is processed to become a photomask for use in semiconductor manufacturing.

photomask. A glass plate covered with an array of patterns, used to form circuit patterns on semiconductor wafers. Photomasks may be made of emulsion, chrome, iron oxide, silicon, or a number of other materials.

photoreceptor. The photoreceptor is the central element in an electrophotographic copier or nonimpact printer. The photoreceptor consists of two parts; a support or substrate, usually in the form of a drum or flexible belt, and a photoconductive coating consisting of one or more layers.

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photoresist. The light-sensitive film spun onto semiconductor wafers and exposed using high-intensity light through a photomask.

photosensitive. Capable of emitting electrons when struck by light rays.

photosensitive plotter. A plotter that uses photosensitive properties to create an image.

photosensor. An optoelectronic semiconductor that responds to radiant energy. Examples are photodiodes and phototransistors.

physical property test, inspection, and measurement. An instrument designed to inspect and measure physical property.

physical vapor deposition (PVD). A process through which specific materials are physically layered on a wafer. Includes sputtering and evaporation.

pin diode. A diode made by diffusing the semiconductor with p-dopant from one side and n-dopant from the opposite side with the process so controlled that a thin or intrinsic region separates the n and p regions. (See also **power diode.**)

PLA. See **programmable logic array.**

placement. End-user consumption of a product that is either purchased, leased, or rented.

planning. An application that facilitates the quantitative aspects of business planning, such as modeling, budgeting, analysis, and forecasting.

plasma etchant. A highly ionized gas (plasma) in the manufacture of high-density semiconductors.

plastic-processing machinery. Numerically controlled machinery used for injection, structural foam, extrusion, blow molding, thermoforming, and reaction injection.

plastics. 1: A polymetric material of large molecular height that can be shaped by flow; usually refers to the final product. Examples include polyvinyl chloride, polyethylene, and urea formaldehyde. 2: Displaying or associated with plasticity.

PLC. See **programmable logic controller.**

PLD. See **programmable logic device.**

plotter. 1: A recorder that charts, in graph form, a dependent variable as a function of one or more variables with an automatically controlled pen or pencil. 2: Any (vector or raster) computer hard-copy devices that perform mainly graphics functions. These devices include pen plotters, electrostatic plotters, photographic and laser plotters, and ink jet plotters.

PMD. See **programmable multilevel logic device.**

PMOS. See **p-channel metal oxide semiconductor.**

PMR. See **private mobile radio.**

PMR. See **projection microradiography.**

PNPP. See **page, nonimpact, plain paper.**

point-of-sale terminal. A terminal device that operates as a cash register in addition to transmitting information.

polysilicon. A silicon layer grown on a wafer in a furnace.

population. The total of individuals occupying an area or making up a whole. A *de facto* population should include all persons physically present in a country (state, province, region, city, or town) or designated area at a reference date. A *de jure* population, by contrast, should include all usual residents of a given country or designated area, whether or not they are physically present at the reference date. By definition, therefore, a *de facto* total and a *de jure* total are not entirely comparable.

portable electronic measuring instrument. An electronic measuring instrument that can be carried or transported with ease.

portable radio receiver transmitter. A device for converting radio waves into perceptible signals.

portfolio management. A software application that allows investors to clarify, estimate, and control the sources of risk and return in their portfolio.

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postsecondary education. The provision of formal instructional programs with a curriculum designed primarily for students who have completed the requirements for a high school diploma or equivalent.

potentiometer. A device for the measurement of an electromotive force by comparison with a known potential difference.

power diode rectifier. A diode is a two-terminal device that permits current flow in only one direction. This property is used in diodes and rectifiers to convert AC current to DC.

power grid control. See **power management.**

power IC. An analog integrated circuit that can control one or more amps of current, dissipate one or more watts of power, or is capable of operating with voltages exceeding 100 volts.

power management. A real-time application that monitors and controls power generation equipment and power line grids.

power supply. 1: A unit that supplies electrical power to another unit. 2: Energy source that provides power for operating electronic apparatus.

power train. The mechanism by which power is transmitted from the engine to other part of the vehicle that it drives. Examples include ignition, spark timing, fuel control, turbo control, emissions systems, voltage regulator, alternator, engine control, and diagnostics.

power transistor. 1: A transistor that dissipates power of one or more watts. 2: A transistor designed for high-current, high-voltage applications.

premises switching equipment. Voice equipment that provides switching or call-routing functions. Includes equipment such as PBX telephone system and key telephone system.

presentation graphics. 1: A software application with a principal function of formatting text or numeric data into specified formats for the presentation of ideas. This may include graphs, charts, and/or lists suitable for professional presentations. 2: An image written, printed, drawn, or engraved; an image outlined or set forth for commercial, professional, or industrial purposes.

print element. The mechanisms used in fully formed character printers and typewriters by which marks are made on the paper. The three types of print elements are printwheels, also known as daisywheels, golf balls, and thimbles.

printer. The unit that produces copy on paper—a typewriter or a line printer. Often connected to a CPU that transforms electronic data into hard-copy form. (See also **ink jet printer** and **line printer.**)

printer controller. 1: Within a printer, the device used to regulate, accelerate, decelerate, start, stop, reverse, or protect devices connected to an electric controller. 2: A device or instrument that holds a process or cartridge at a desired level. 3: Hardware and/or software, usually either printed circuit board- or diskette-based, that takes data streams from software and converts it to printer-specific commands. The controller may reside in a CPU; may be connected to the print engine by an interface cable, a diskette or chip set in the CPU or printer; or, as in most cases, may be a physical attachment to or integrated component of the printer itself.

printer controller board. See **printer controller.** (Except all devices are loaded onto a board.)

printer, impact. Family of printers that use direct impression impact of a typebar, type head, or matrix pin to exert pressure against a paper ribbon and a platen to create a character.

printer, nonimpact. A printer capable of imaging on a substrate without physically striking it; these include ink jet, laser, and thermal printers.

print system network. Hardware and software that is integrated to manage the information sent to one or a number of printers, usually shared by more than one user. The system may be as simple as a switch box connected to two CPUs and one printer, or as complex as a full local area network that controls print streams to many printers from multiple CPU systems and controls job-queuing management, printing error conditions, spooling, and rerouting.

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printwheel. A print element for certain character printers. The characters are engraved at the end of spokes, the entire printwheel resembling a daisy. Also known as daisywheel.

private automatic branch exchange (PABX). One type of telephone switching system that is typically used in larger businesses. The PABX allows computer-like programming of incoming and outgoing calls to optimize network configurations and provide additional call management features.

private line. A telecommunications network connection for the exclusive use of one organization. (See also **leased circuit.**)

private mobile radio (PMR). See **cellular service.**

private packet data switching. A private packet data network switch connects terminals and packet assemblers/disassemblers to a packet node using a high-speed link (56,000 bps). (See also **packet data switching.**)

private school or institution. A school or institution that is controlled by an individual or agency other than a state, a subdivision of a state, or the federal government; usually supported primarily by funds other than public funds; and is operated by other than publicly elected or appointed officials.

process control, nonunified system. System-type instruments and related equipment for process control activated from standardized electrical transmission signals, in which control and signal conditioning are separated from the display and operator interface.

process control system. 1: Monitoring and maintaining the operation of plants that manufacture homogeneous materials such as oil, chemicals, and paper. Process control systems are capable of detecting errors in input variables and environment and taking corrective action. Closed-loop systems are self-correcting, and open-loop systems alert an operator. 2: A computer-based system that controls physical transformation and/or the mixing of products in a fluid state.

process control system, auxiliary station. Peripheral equipment of a process control system not in direct communication with the central processing unit or system.

process control system, controller. The controller describes that portion of a process control system that continuously measures the value of a variable quantity or condition and then automatically acts on the controlled equipment to correct any deviation from a desired present value.

process control system, indicator. A portion of the process control system that produces a diagram measuring the pressure volume changes in a running system.

process control system, industrial process computer. A computer that monitors the manipulations and changes of numerous conditions within a process control system automatically.

process control system, recorder. A portion of a process control system that makes a graphic or acoustic record of one or more variable quantities.

processing terminal. A display terminal that has local processing capability but is dependent on communication with a host, controller, or server to provide files and application programs. Such a terminal does not have a mass data storage device.

process manufacturing. 1: *Continuous process* produces a continuous stream of products, the units of which are not differentiated from one another (i.e., gasoline). 2: *Batch processing* produces product by reference to a recipe (i.e., bread).

processor. A device for handling information in a sequence of reasonable operations. Any device that can perform operations on data.

process planning and control. See **process control system.**

process simulation. The computerized simulation of the sequence and interdependencies of manufacturing processes. Also involves process modeling and includes NC part programming as a subset.

product. A good or service.

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product category. A grouping of similar products.

production. The manufacture of goods.

production planning and control. Software used to plan for factory resources of a manufacturing company.

professional publishing. Systems dedicated exclusively to the job of publishing; typically, PC-based professional publishing systems focus on a single task or stage in the document production cycle, rather than managing the entire document production process.

professional services. A range of services including consulting on information technology, contract/custom programming, systems integration, facilities management, education, and ongoing maintenance.

programmable array logic (PAL). PAL is a trademark of Monolithic Memories, Inc. (now part of Advanced Micro Devices), referring to a family of logic devices that are customer programmable.

programmable logic array (PLA). 1: A form of programmable logic device containing a structured, partially interconnected set of gates and inverters that are fuse programmed by the user. Can be manufactured in bipolar or MOS technology.

programmable logic controller (PLC). A device or transmission control unit in which hardwired functions have been replaced with software or microcode. A programmable controller enables a user to add, change, or tailor computer capacities to the user's needs; programmable solid-state devices that replace mechanical relays for controlling sequential operations, timing, counting, and similar simple control actions. Where the capabilities exist as a function of the PLC, this definition includes more sophisticated tasks such as mathematical computations, data acquisitions, reporting, and process equipment control.

programmable logic device (PLD). A type of application-specific integrated circuit (ASIC) that is user programmable (after assembly) rather than mask programmable. The function of a PLD is determined by blowing fuse links or programming memory devices to create the desired interconnections between the fixed logic elements on the device. Can be either a bipolar or MOS technology. (See also **programmable logic array.**)

programmable machine tool. Numerical control (NC), computer numerical control (CNC), direct numerical control (DNC), and flexible machining centers used for metal cutting and metal forming.

programmable multilevel logic device (PMD). A semiconductor that can be manufactured by a bipolar or MOS technology process. The device, evolved from the basic programmable logic array (PLA), incorporates architectures to implement complex logic functions efficiently. PMDs can implement multiple levels of logic without sacrificing input/output or I/O cells or pins.

programmable read-only memory (PROM). A nonvolatile fuse-programmable solid-state memory circuit that is programmable only once, with special equipment. It is a programmed ROM that may be programmed after manufacture by blowing fuse links or shorting base-emitter junctions. PROMs provide high-speed access to frequently needed data and instructions. They allow a vendor company to customize a system before delivery to the user.

projection/aligner. Wafer fabrication lithography equipment that uses mirrors instead of lenses. The wafer and mask are separated by distance, not allowing the entire wafer to be exposed. This process lines up two or more layers of a wafer so that the components of one layer are compatible with the components of the other layer. (See also **lithography.**)

projection microradiography (PMR). An electron beam is focused onto an extremely fine pencil, generating a point source of x-rays; enlargement is achieved by placing the sample very near this source and several centimeters from the recording material.

project management. A software application that supports the ordering of activities across time. This application assists in planning and implementing projects by providing tools for forecasting requirements, projecting costs, and providing other charting and analysis features.

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PROM. See **programmable read-only memory.**

prosthetic medical equipment. Equipment used in the surgical and dental specialties concerned with the artificial replacement of missing body parts.

protocol. A set of rules (not a program) for software programs to conform with in data communications. A program that reacts properly to data sent to it in a form that does not conflict with these rules and that sends data in conformance with these rules is said to support, or be in compliance with, the particular protocol. An example of a protocol is the one used by humans over two-way radio: the protocol is that one person finishes speaking by saying "over"; the other party then speaks, until finished and says "over"; the end of transmission is signalled by saying "over and out." Examples of protocols in data communications are BSC (IBM) and T201 (Tymnet).

protocol converter. Equipment that converts data from one format (protocol) to another. (See also **gateway.**)

proximity/contact aligner. Equipment that places a mask in direct contact with the wafer after the mask is aligned. With proximity, the mask does not come into direct contact with the wafer. (See also **lithography.**)

PTT. Postal, telegraph, and telephone organization. An organization that provides basic telecommunications services. For U.S., see regional bell operating companies.

public data network service. A packet-switched or circuit-switched network service available for public use. It includes the equipment and service charges associated with data communications networks that are offered to the general public. These networks connect user terminals and computers to the network and may offer enhanced or value-added services, such as conversion of speeds, codes, protocols, electronic mail, or facsimile.

public packet data switching. See **packet data switching.**

public school or institution. A school or institution controlled and operated by publicly elected or appointed officials and deriving its primary support from public funds.

public switching equipment. Equipment used in public telecommunications to switch or route voice and data calls. This segment includes equipment such as digital central office switching equipment and digital access cross-connect systems.

public telecommunications equipment. Equipment that includes public network services and equipment. It includes the various voice and data communications services provided by common carriers and the transmission and switching equipment used to implement these networks.

public telecommunications service. A service provided by public telecommunications carriers. It includes services such as local telephone, long distance telephone, international telephone, leased circuit, public data network, enhanced network, and mobile communications.

public transmission equipment. The equipment used in public telecommunications to transmit voice and data signals. It includes equipment such as multiplex equipment, carrier equipment, microwave radio equipment, and satellite earth state equipment.

publishing. 1: The business or profession of the commercial production and issuance of literature and information. 2: Computer-aided systems to automate the creation and printing of documents.

punch/shear/bend programmable machine tool. Describes the action that occurs to a composite or material, generally metal, on a machine. Punching literally punches a hole in the material, shearing cuts the material, and bending forms the material to a specified predetermined shape. These three activities are performed on three separate machines.

purchasing. A software application that has computer-assisted generation or procurement documents specifying materials, quantities, and delivery times.

purchasing and vendor management. Contains statements as to the quantity, description, and price of the goods; agreed terms as to payments, discounts, date of performance, and transportation.

PVD. See **physical vapor deposition.**

PW—private wire leased circuits. See **private line.**

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Q

QC. See **quality control.**

QC analysis. Quality control analysis is generally performed throughout the manufacturing process, comparing the actual part shape or feature size to the design specification.

quality. The measure of how well a product or service meets customer expectations. Alternately, the ability to produce consistently a product or service within control limits or well-defined specifications.

quality assurance. The establishment and execution of procedures to measure product quality and adherence to acceptance criteria.

quality control. Process by which product is measured to ensure conformance to specification and standards.

query language. A generalized computer language that is used to interrogate a database.

R

R&D. See **research and development.**

radar. A radio device used to locate objects by frequency waves reflected off the object and received by the sender, allowing the sender to determine characteristics of an object. Includes airborne, shipboard, and ground search, flight control acquisition, detection, tracking, and associated test systems.

radio. 1: The use of electronic waves/signals to produce sound. 2: Home radio receivers including AM, AM-FM, and FM radios that are classified as table models, clock models, and portable radios. This category does not include high-fidelity receivers, radio-phonograph combinations, and television receivers, nor does it include automobile radios, stereos, or tape players.

railroad control. An application that monitors and controls railroad and urban rapid transit traffic.

RAM. See **random-access memory.**

random-access memory (RAM). An integrated circuit permitting read-and-write access to any memory cell or address in a completely random sequence. Can be of either bipolar or MOS technology process. A memory device with the qualities of allowing arbitrary reading or writing of a desired data location. The system accesses the addressed material without reading through intervening data. Information may be retrieved more speedily from RAM than from serial media, such as tape. Also called read-and-write and scratch-pad memory.

rapid thermal processing (RTP). Process that uses machines of low temperature for contact alloying and systems for the deposition of thin gate oxides. Similar to the diffusion furnace.

RBOC. See **regional bell operating company.**

reactant gas. Molecules that act upon one another to produce a new set of molecules.

read-only memory (ROM). 1: Computer memory that can be read from but not written to. Permanent memory on chips wherein information can be retrieved but not stored. Memory is not lost when the power to the computer system is turned off. 2: A memory device the contents of which can be read but not altered. (See also **mask ROM.**)

real estate. An environment or industry that includes owners, lessors, lessees, buyers, sellers, agents, and developers of real estate.

real-time clock. A clock that indicates actual time, such as elapsed time, as opposed to a fictitious time established by a program.

real-time data acquisition and control. 1: The process by which events in the real world are translated to machine-readable signals. 2: Automated systems in which sensors of one type or another are attached to machinery. 3: Data processing is performed so that the results are available in time to influence the controlled or monitored system.

reconnaissance. Equipment used to secure data/information about activity and resources concerning an enemy or potential enemy's territory.

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reduced-instruction-set computing microprocessor (RISC MPU). The number of instructions a microprocessor runs for a specific application are reduced from a general-purpose complex-instruction-set computing (CISC) microprocessor to create a more efficient computing engine.

reel-to-reel tape drive. A tape format in which the running tape is wound onto a separate take-up reel. Also known as open reel.

regional bell operating company (RBOC). Seven holding companies formed by the divestiture of AT&T to provide regulated and nonregulated telecommunications services in the United States.

relational database management system. A software application for the storage, retrieval, update, and analysis of multiple databases. These databases are linked (related) through one or more identical fields, called keys.

relay. 1: An electronic or electromechanical device for transferring a signal from one electrical circuit to another. 2: To forward a message through an intermediate station. (See also **passive device.**)

remote batch. A method of entering jobs into the computer from a remote terminal.

remote control. Any system of control performed from a distance. The control signal may be conveyed by intervening wires, sounds, light, or radio signals.

remote processing. A procedure in which the operating system can be used to process messages received from remote locations via telephone lines and telephone equipment. In effect, it is an extension of the data processing and programming facilities of the computer to remote locations.

remote sensing. The acquisition of information (usually in the form of an image) about an object or area by recording electromagnetic radiation emanating from or reflected from the target. The electromagnetic energy is received and processed by a detector system that is not in physical contact with the target under study. Common platforms for detector systems are aircraft and satellites, but the definition is not restricted to these two.

removable media disk drive. Removable media rigid disk drive has the platter enclosed in a housing that is designed to be user-accessible.

replacement demand. The subsequent demand by end users for new equipment.

research and development (R&D). Basic and applied research directed toward the discovery, invention, design, or development of new products and processes.

research supercomputer. An information system defined by a minimum of 32 low-performance computing nodes. Optimized to run highly parallel applications. Price ranges between $300,000 and $2 million.

residual value. The value of a product at the end of its useful life. Typically used with depreciation and leasing calculations.

resistor. A passive device that measurably opposes the passage of an electric current (e.g., doped silicon). (See also **passive device.**)

respiratory analysis. Equipment used to examine, detect, and analyze the respiratory system.

retail trade. An environment or industry that includes establishments engaged in selling merchandise for personal or household consumption and rendering services incidental to the sale of the goods. In general, retail establishments are classified by kind of business according to the principal lines of commodities sold.

retirement. The number of products that are removed from use. A product is considered retired from the installed base if it is scrapped, returned to the manufacturer, or placed in storage.

return. The number of units previously sold outright that have been returned or retired by the customer. (See also **retirement.**)

revenue. The amount of money that a company receives from its customers for goods and services.

rewritable optical disk drive. An optical disk drive that uses removable media that can be erased and reused many times (also called erasable optical disk drive).

ribbon. A strip of inked material or fabric, which when struck with a print element forms a character on paper. (See also **single-strike ribbon, web ribbon, film ribbon, multistrike ribbon.**)

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rigid disk. See **rigid disk computer storage media.**

rigid disk computer storage media. A rigid disk has a nonflexible substrate and can be made of aluminum, plastic, glass, or other rigid material.

RISC MPU. See **reduced-instruction-set computing microprocessor.**

robot. A reprogrammable multifunctional manipulator designed to move objects through variable motions for the performance of a variety of tasks. Intelligent robots commonly rely on vision systems to control their behavior through their ability to recognize objects.

robotic electronic assembly. Electronic manipulative machines that can perform functions ordinarily ascribed to humans in the assembly of material.

robotic nonelectric assembly. Same as robotic electronic assembly except that robots are mechanically maneuvered rather than through the methods and principles of electronics.

robot programming and simulation. The use of computer-controlled manipulators or arms to automate a variety of manufacturing processes such as welding, material handling, painting, and assembly.

robot system. Programmable manipulative machines that can perform functions ordinarily ascribed to humans. Included are robotic mechanisms, control hardware and software, and all associated peripheral equipment. These peripherals include end effectors and grippers that are used for the processing of parts, tools, and assemblies within the factory.

ROM. See **read-only memory.**

routing. An application that supports route planning. It is used to schedule the sequence of stops a transport vehicle makes.

RTP. See **rapid thermal processing.**

S

safety and convenience. Equipment related to the automobile and truck industry including devices that prevent loss, hurt, or injury, or that lend ease and comfort to passengers. Examples include: climate control, light reminder, keyless entry, heated windshield, sensing wipers, automatic door lock, automatic headlights, dimming, rear window defogger, antiskid braking, window control, and airbags/restraint control.

satellite. 1: A specialized radio transmitter/receiver placed in orbit around the earth to provide transmission channels for information to be transmitted over great distances. 2: A celestial body orbiting another of larger size.

satellite communication equipment. Equipment used for communication by use of an active or passive satellite to extend the range of a radio, or other transmitter, by returning signals to earth from an orbiting satellite.

satellite earth station equipment. The total earth-based equipment used in connection with orbiting, geostationary satellites. This category includes the Very Small Aperture Terminals (VSAT), as well as the antennae and electronic transmitting/receiving terminals.

scanner. Input devices used for the optical sensing of images and text and/or graphics for conversion to dot patterns for incorporation into a document. This category includes both ICR and OCR scanners with a resolution of less than 400 dpi.

scheduling. An application that supports the scheduling of events.

schematic. This is a detailed diagram. In a mechanical application, schematics are used to describe hydraulic and pneumatic systems. A set of symbols are available for both applications representing standard components.

scholarships and fellowships. College expenditures applying only to money given in the form of outright grants and trainee stipends to individuals enrolled in formal coursework, either for credit or not. Aid to students in the form of tuition or fee remissions is included. College work-study funds are excluded from this category and are reported under the program in which the student is working.

Schottky TTL (STTL). A form of transistor-transistor logic using Schottky diodes as transistor clamps to increase the speed of circuit operation. A high-speed form of bipolar logic.

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scientific application. A diverse group of software applications covering varied subject matter and research on the natural sciences when these are concerned with the physical world and its phenomena. Applications are divided into two subcategories: general analysis and scientific research. General analysis is the use of computers to solve various technical problems and to further research on subjects; this use is generally mathematical in nature. Scientific research applications are used specifically in the following fields: thermonuclear chemistry, nuclear physics, general physics, mechanical sciences, electronics research, geophysics, fluid dynamics, thermodynamics, materials research, and genetic engineering.

scientific research. A software application that pertains to research and development, not to applied science.

scientific visualization. An image computer is used for scientific modeling, technical data analysis, medical imaging, or similar large-volume data analysis.

security. 1: The existence and enforcement of techniques that restrict access to data and the conditions under which data can be obtained. 2: A measure taken by a command to protect a system from espionage, observation, sabotage, annoyance, or surprise. 3: Protection of a system by use of commands and codes.

security/energy management. Safety and power management within industrial equipment and manufacturing.

seismic analysis. 1: Seismic analysis helps support exploration activities by indicating favorable conditions for finding oil or coal reservoirs. 2: Analysis relating to an earth vibration caused by earthquakes, or other natural phenomena.

semiconductor. 1: A group of materials that are electrical nonconductors in a pure state that can be altered by the selective introduction of impurities into its crystalline structure. Its resistivity can sometimes be changed by light, an electric field, or a magnetic field. 2: An electronic device made using semiconductor material.

semiconductor tester. Equipment designed to test, check, and monitor the functionality of electronic circuit packages of varying complexity and functionality.

serial, impact, dot matrix (SIDM). A printer that creates a character image by selectively placing individual dots on the substrate using mechanical force.

serial, impact, fully formed (SIFF). A printer that prints one character at a time using type elements to create fully formed character impressions.

serial input/output (SIO). 1: A device that permits data to be transmitted into and out of a computer over a single conductor one bit at a time. 2: Pertaining to time sequential transmission of, storage of, or logical operations on parts of data words. 3: A technique for handling binary data words (which have more than one bit). 4: A device or technique where data are transferred to or from an I/O port in a serial or in-line manner.

serial, nonimpact, direct thermal (SNDT). A printer that creates the desired image a dot at a time using point-specific heat and a heat-sensitive substrate that changes color when exposed to heat.

serial, nonimpact, ink jet (SNIJ). A printer that creates the desired image a character at a time by emitting ink from an array of orifices or nozzles.

serial nonimpact, thermal transfer (SNTT). A printer that creates the desired image a dot at a time using point-specific heat to transfer ink from a ribbon to a receiving substrate.

server. A processor that provides a specific service to a network, such as connecting nodes of different networks.

services. Intangible items of trade, such as education, transportation, banking, and legal and medical care.

SFDSP. See special-function DSP products.

sheet feeder. A sheet feeder is mounted on top of a printer and automatically inserts cut sheets into the printer and receives the ejected paper in a hopper. Sheet feeders may be single or dual tray

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for the feeding of letterhead and second sheets, or they may incorporate an envelope-feed tray for the printing of letters and envelopes simultaneously.

shipment. The number of products delivered.

shop floor and cell control. A system for utilizing data from the shop floor as well as data-processing files to maintain and communicate status information on shop orders and work centers. Provides actual output data for capacity control purposes.

shop floor planning and control. See **shop floor and cell control.**

SIDM. See **serial, impact, dot matrix.**

SIFF. See **serial, impact, fully formed.**

silicon epitaxy deposition. A process through which vaporized silicon is deposited on a wafer. (See also **deposition.**)

silicon precursor gas. A specialty gas used in semiconductor manufacturing. Gases such as silane, dichlorosilane, trichlorosilane, and silicon tetrachloride are used in epitaxial and chemical vapor deposition (CVD) processes to deposit layers of silicon or silicon components onto silicon substrates.

silicon wafer. A nonmetallic element that is the most widely used semiconductor material today. Silicon is used in its crystalline form as the substrate of semiconductor devices.

simulation. An application or system that uses representative or artificial data to reproduce various conditions in a model that are likely to occur in the actual performance of a system. Simulation frequently is used to test the behavior of a system under different operating policies.

simulation and training equipment. Equipment used to augment the acting out of real-life maneuvers/exercises as training in preparation for real-life situations. Equipment includes aircraft, flight and situation simulators, equipment operation, and maintenance systems.

single-strike ribbon. A film ribbon. Each time a character strikes the ribbon, the ribbon advances far enough so that the next character has a completely new ribbon area to strike. The ink formulation is such that the ink on the ribbon is depleted from the area where the print element strikes the ribbon. These ribbons produce the highest print quality, but ribbon life is low compared with that of fabric and multistrike ribbons.

single-user enhanced system. See **workstation computer.**

SIO. See **serial input/output.**

slow SRAM. A random-access memory (RAM) integrated circuit (IC) that runs at speeds greater than 70 nanoseconds. (See also **static random-access memory.**)

small-format pen plotter. A computer plotter that uses engineering-size A (8.5 x 11 inches) or B (11 x 17 inches), architectural-size 1 (9 x 12 inches) or 2 (12 x 18 inches), or metric-size A4 (21 x 29.7 centimeters) or A3 (29.7 x 42 centimeters) media. (See also **plotter.**)

small-signal diode. A diode with a forward current of less than 100 milliamperes (0.1 amperes). The sides of the silicon chip are metallized and encapsulated in a tubular glass package.

small-signal transistor. A transistor that dissipates power of less than 1 watt.

smart card. A credit card or credit-card-size device that contains one or more integrated circuits. These devices usually are carried by an individual. Common applications include financial transactions, record keeping, and user identification.

smart interactive terminal. See **intelligent terminal.**

smart power. An integrated circuit (IC) that contains both control logic circuits and power control elements.

smoke alarm. A detector that is activated automatically when exposed to smoke.

SNA. See **system network architecture.**

SNDT. See **serial, nonimpact, direct thermal.**

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SNIJ. See **serial, nonimpact, ink jet.**

SNTT. See **serial, nonimpact, thermal transfer.**

socket. An opening that supports and electrically connects to vacuum tubes, bulbs, or other devices or components when they are inserted into it.

software. 1: Any set of explicit procedures constituting a computer program. 2: Programs, procedures, rules, and any associated documentation pertaining to computer operations.

software support service. Activities that assist the end user in use and implementation of software products. Software support includes bug fixing, updates, and documentation, as well as support of ongoing operating problems including product-specific consulting, programming services, and training.

solar cell. A pn junction device that converts the radiant energy of sunlight directly and efficiently into electrical energy.

solid modeling. An application that represents the external and internal part geometries, allowing the solid nature of an object to be represented in a computer. Solid models are constructed in two ways: using primitive building blocks (constructive solid geometry) and/or using boundary definitions (boundary representation).

solid state. Pertaining to circuits and components using semiconductors. (See also **semiconductor.**)

solid-state subsystem. Computer memory products that comprise a block of semiconductor memory, a controller/formatter for it, a power source or access to power, a host bus interface, hardware, and software. These include modules external to the computer and kits for installation inside computers.

sonar. A device used to detect submerged objects by sonar waves reflected off the object. Also can be used to measure depth or distance. Includes search, detection, tracking, guidance, navigation, communication, sonabuoys, and associated test systems.

SONET. See **synchronous optical network.**

space military equipment. Military equipment used beyond the earth's atmosphere. Includes satellites with accompanying communication and reconnaissance equipment, various other space platforms, launch vehicles, and ground control.

special automotive IC. An analog IC designed for a specific automotive application.

special consumer IC. An analog IC designed for use solely in consumer home entertainment and appliance products.

special-function analog IC. An analog integrated circuit function used in specialized applications. Examples are sensors, timers, and oscillators. These devices differ from application-specific standard products (ASSPs) in being functional blocks rather than complex configurations of functions for specific applications.

special-function DSP products (SFDSP). Products built using DSP techniques and architectures but designed for specific functions. Examples include: modems, codecs, speech processors, digital television circuits, digital filters, and fast Fourier transform (FFT) chips. Generally, these devices cannot be programmed by users to perform operations other than their defined function.

special-function IC. A linear IC that does not fall into the standard product categories. This product has a specific function such as timer, oscillator, signal generator, or sensor but is not limited to a single application or market.

special-purpose computer system. A computer system designed for a specific purpose. For example: a banking computer system, word processor, or cash register.

specialty gas. A gas used in manufacturing semiconductors that is supplied in gas cylinders rather than in bulk because smaller volumes are used.

splice. A joint used to connect two lengths of conductor with good mechanical strength and good conductivity. (See also **passive device.**)

spot-welding robot system. A robot carries a resistance welding gun to produce welds.

spreadsheet. An application with the principal function of organizing data into columns and rows to allow the user to perform numerical analysis.

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SRAM. See **static random-access memory.**

standard cell. An integrated circuit designed to a customer's specifications using precharacterized cells as building blocks.

standard logic. Off-the-shelf integrated circuits belonging to "families." Bipolar digital families include AS, FAST, LS, and ALS. MOS digital families include HC, HCT, and FACT. Standard logic is available from a number of suppliers and may be used in many different applications. Sometimes referred to as glue logic. Normally has less than 150 logic gates.

start-stop tape drive. A tape drive that starts and stops on reading or writing a data record.

state government. One of the constituent units of a nation having a federal government.

static random-access memory (SRAM). A RAM that maintains memory as long as power is applied and does not require refreshing. SRAM densities can range from 1K, with approximately 1,000 bits, to 4Mb, with approximately 4 million bits.

statistical multiplexer. An electronic device that consolidates several data streams onto a single high-speed bit stream for transmission over a telephone line.

stepper. A semiconductor manufacturing device that uses a step-and-repeat process to transform the pattern image of a reticle or mask onto the surface of the semiconductor wafer.

stereo headphone. A device worn on the head that permits the transmission of sound through two earphones connected by a band.

stereo (hi-fi) component. Equipment that produces high-fidelity reproduction of sound.

storage controller board. 1: A board containing input data or parameters for an application of a general routine. 2: Those parts mounted on a board that carry out the instructions in proper sequence, interpret each instruction, and apply the proper signal.

storage management. Functions that manage the storage of information in which information can later be retrieved. Includes storage protection, storage temperature, storage print, and storage allocation.

storage subsystem. Computer memory product that comprises a storage device(s), a controller/formatter for it, a power source or access to power, a host bus interface, hardware, and software. These include modules external to the computer and kits for installation inside computers.

streamer tape drive. A tape drive that uses a continuously moving tape; one that does not start and stop on each data record.

streaming tape drive. Tape drives (1/4-inch and 1/2-inch width) where the data stream over the head without stopping (continuous flow).

structural. The dynamics of the physical system; usually refers to the static stability/integrity of a part, assembly, or system.

structural modeling/analysis. A software application for modeling and analysis of the integrity of a structure.

STTL. See **Schottky TTL.**

studio transmitter link. Equipment used to generate and amplify a radio signal.

styling. A detailed design process where aesthetic considerations are foremost. Systems supporting this application have special refinements for rendering, modeling, and editing functions.

subsidiary. A company partially or wholly owned by another company.

supercomputer. A high-performance computer designed for numerically intensive applications. The current price ranges from approximately $100,000 to $20 million.

superminicomputer. An information system with price ranging typically from $100,000 to $1 million, with a minority below $100,000. CPU bit width ranges from 32 to 48 bits, with emphasis on 32. Environment is almost exclusively an ordinary office with no special environmental controls. Equipment typically is supported full-time by a professional computer systems support staff of fewer than 10 members. It usually is built around proprietary processor and typically supports from 32 to 350 concurrent users. Examples of models are the HP 3000/930 and 950, DEC VAX 8700 and Micro VAX 3500, and IBM 9370.

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superworkstation. A superworkstation has higher graphics performance than a traditional workstation. It also has a higher processing performance rating to support graphic computations. The average price is $40,000 to $80,000 with performance ratings of 8 to 20 mips and 2 to 16 mflops.

surgical support. Equipment relating to, or having connection with, surgery.

surveying and drafting instrument. An instrument used to detect, access, and measure radiation. The instrument is used in the drawing of objects, structures, or systems by engineers and scientists.

switch. 1: A mechanical or electrical device that competes with or breaks the pattern of a current or sends it over a different path. 2: A device that connects, disconnects, or transfers one or more circuits and is not designated as a controller, relay, or control valve. (See also **passive device.**)

switch/multiplexer IC. Analog switches gate analog signals under the control of logic. Multiplexers are specialized analog switches that select only one of many inputs.

synchronous optical network (SONET). An emerging standard for optical networks.

system management. The administration and operation of a computer system including staffing, scheduling, equipment, and service contract administration, equipment utilization practices, and time-sharing.

system network architecture (SNA). An IBM standard for data communication.

systems integration service. The implementation phase of tying together dissimilar devices. Services are coordinated by a single contractor who manages the procurement, installation, integration, and support of all software, hardware, and communications devices.

systems integrator. See **value-added reseller.**

system software. Software that provides support structure in which applications may operate. This includes operating systems, operating environments, and utilities.

systems planning and design. "Front-end" consulting services that are required to determine the nature of a customer's needs and the actions necessary to meet those requirements.

system subroutine library. An organized collection of computer programs that is maintained online with a computer system by being held on a secondary storage device and is managed by the operating system.

system support peripheral. An integrated circuit (IC) considered a traditional peripheral, where each processor has a set of six to eight dedicated peripherals that provide rudimentary functions necessary to construct a microprocessor (MPU)-based system. (See also **traditional peripheral.**)

system utilities. Products that aid in the maintenance and/or repair of computer hardware, operating systems, or data recovery.

T

2-D modeling. The representation of a part in two dimensions (has an x and y coordinate). This format requires three or more views (top, front, side) to depict all aspects of the part. This is the most common geometric modeling format and is used extensively with a drafting function.

3-D modeling. The representation of a part in three dimensions, usually in a wire-frame format (has an x, y, and z coordinate). This format is used commonly in high-level CAD systems to determine the placement and fit of components in an assembly. This format is not generally used for final drafting, although some systems have the capability to translate the 3-D image to a 2-D standard drafting format.

T-1. A high-speed, time-division, digital network link operating at 1.544 Mbps and above.

T-1 multiplexer. A unit that allows multiplexing, or combining, several voice and/or data channels onto one communications link, in this case, a high-speed T-1 channel.

tape drive. A class of computer backup device that uses reel-to-reel, cartridge, or cassette tapes as media.

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tape recorder. A device that records and plays sound from magnetic tape.

tax accounting. An application concerned with keeping records for tax purposes, setting up accounts for paying taxes, making tax computations, and preparing tax returns.

TDM. See **time-division multiplexer.**

teaching machine and aid. Equipment designed to assist in the training, educating, and instructing of persons to acquire knowledge or skill in a particular field(s) of interest.

technical data analysis. An application that analyzes technical or experimental data. The data may have been generated from instruments, captured from other electronic measuring devices (such as thermocouples or strain gauges), or generated by other analysis programs.

technical illustration. A drawing of a component or assembly that generally is intended for publication. This drawing will omit unnecessary dimensions and other detailed drating items and will be drawn so as to depict the part realistically.

technical productivity. An application that enhances the productivity of technical disciplines and is specialized for the engineering, scientific, or manufacturing fields.

technical publishing. The printing of user manuals or guides.

telecommunication integrated circuit (IC). An analog IC designed for the voice and data communication market.

telecommunications. Products and services that provide or manage the flow of information from person to person, person to machine, machine to person, or machine to machine. The telecommunications market is segmented into a combination of the premises and public telecommunications market segments.

telecom services. Includes that portion of telecommunications charges related to access and use of the public network. These charges typically are seen as a monthly usage charge for local, long distance, and private line access/utilization.

teleconferencing. Equipment and services related to one-way and two-way video communications that use specialized video equipment and/or transmission networks. These communications enable conferencing between locations.

telemarketing. A sales method that employs a sales force to move a product through the distribution channel by contacting the consumer via the telephone. Also referred to as inside sales.

telemetering system. See **telemetry.**

telemetry. Transmission of data from remote measuring instruments by electrical or, usually, radio means.

telephone. A terminal or handset used for voice and data transmission and communications. It functions as an interface between a user and a telephone switching system.

TELeprinter EXchange (TELEX). A worldwide dial-up telegraph service enabling users to communicate directly and temporarily among themselves by means of start-stop apparatus and circuits of the public telegraph network.

teletex. An interactive communications network designed for transmission of text and graphics to televisions or other low-cost terminals.

TELEX. See **TELeprinter EXchange.**

tension arm tape drive. A 1/2-inch reel-to-reel tape drive that uses mechanical tension arms to provide tape tension and buffing.

terminal equipment. 1: A device at a node of a network through which information can be entered, extracted, or monitored. 2: Any device capable of sending and/or receiving information over a communications channel. Includes a keyboard and display that cannot stand alone because it lacks processing capability. Terminals are usually simple ASCII text-entry devices.

terms and conditions. The provisions of a contract that are stated or offered for acceptance that determine the nature and scope of the agreement.

test and measurement. The process of determining the magnitude of the response of an object to a given stimulus. Also the degree to which an object may be characterized along a dimension

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(quantification of an entity). Computer-based inspection and test systems used for quality and/or process control data analysis; data may be collected by manual input or sensory devices.

test equipment. Equipment designed to test, check, monitor, and identify varying degrees of device functionality and complexity that may include quality, speed, and performance. Automated test systems and equipment such as IC testers and PC-board testers, as well as general test equipment (such as oscilloscopes, spectrum analyzers, and digital multimeters).

text capture. Process whereby words or groups of words are controlled.

therapeutic. Medical applications involved in treating specific medical conditions.

thermal. The effects of temperature on the system.

thermal plotter. 1: A process that produces a visible image by heat-induced chemical reactions or chemically reactive media. 2: A thermally induced phase change process of a pigment-binder mixture, which is transferred from a donor sheet to the media.

thermal transfer printer. An imaging process using heated printing elements to produce prints or copies; can be either dye diffusion (coated paper) or wax based (plain paper). This process currently is used in electronic printing, facsimile machines, and full-color copiers.

thimble. A thimble-shaped print element that floats freely across the platen of a character printer, working in a similar fashion to a daisy-print element. It is shaped like a cup, with the spokes extending around the rim of the cup, with characters positioned at the end of the spokes.

thyristor. A type of diode that consists of a four-layer slice of silicon. The device is characterized by continuous switching. Once a thyristor has been triggered into conducting current, it will continue to conduct current until the main current falls to zero.

ticketing. A software application that supports the sale and management of tickets. The application may be as simple as ticketing a single event or as complex as ticketing airline reservations.

tie ratio. A ratio that describes the relationship between two or more product units, usually used when one product is part of or connected to another product. For example, a disk drive tie ratio to PCs of 0.8 indicates that 80 percent of the PCs contain a disk drive.

time and materials service. Remedial repair services on a per-call basis. Pricing is based on the actual length of time-to-repair, travel charges, and specific parts or materials required to complete repairs.

time-division multiplexer (TDM). One of several technologies used to multiplex, or combine, several voice and/or data channels onto one communications link. TDM uses "time slicing" to allocate blocks of time to each channel. See also **statistical multiplexer.**

TLX. See **TELeprinter EXchange.**

toner. The substance used that develops a latent xerographic image from a photoreceptor onto a substrate, usually paper. Monocomponent toner contains both the imaging material and the carrier (usually called developer) needed to transport the toner to the latent image. In dual-component toner, the imaging material and developer are held separately until they are mixed by the copier or printer itself. Liquid toner has the imaging material suspended in a solvent.

tool design. The design of custom-made tooling to facilitate an effective manufacturing process.

tools. A software program that is used by application developers or users to create applications. Examples are spreadsheets, word processors, editors, macro languages, screen painters, and report generators. Tools are higher-level products than languages; a tool is written in a language. Unlike languages, most tools are nonprocedural, i.e., they do not require users to create code that is sequentially executed. A good example of this is a spreadsheet, where the developer/user navigates up, down, and sideways with the arrow keys or mouse and can add or delete rows and columns at any time. Examples of tools include Lotus 1-2-3 (spreadsheet); Multimate (word processor); EDLIN (line editor); and Ojectworks (graphical editing and object manipulation environment).

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trading turret/dealer board. A specialized type of telephone system that allows simultaneous access to multiple telephone lines. This system is used in any business that requires frequent conversations between two or more parties (i.e., stock brokers).

traditional peripheral. An integrated circuit that has an intermediary control device, which links a peripheral unit to the control processors.

traditional workstation. A midrange workstation priced between $15,000 to $50,000. Its performance ratings are 4 to 15 mips and 0.5 to 2 mflops.

traffic control. A real-time software application, mechanism, and system used to monitor and control, exert control over, and/or enforce the movement of vehicles.

transducer. Any device or element that converts an input signal into an output signal of a different form. (See also **passive device.**)

transistor. A transistor is as a current-amplifying device or switch, as follows: 1: Current amplifying—a small change in a small current flows between the collector and the emitter. 2: Switch—a sufficiently large voltage applied to the base causes the maximum amount of collective current to flow. It can be manufactured in bipolar or MOS technology process. A bipolar transistor consists of a sandwich of doped silicon layers. The transistor has three electrical connections: base, emitter, and collector. Each of these areas provides access to one of the doped regions.

transistor-transistor logic (TTL). A logic circuit design with the diode inputs replaced by a multiple-emitter transistor.

translator. The process performed by an assembler, compiler, or other routine that accepts statements in one language and converts them to another language. 2: A device that transforms signals from one form to another form. 3: A system that has a number of inputs and outputs and is connected so that input signals representing information expressed in a certain code result in output signals that represent the input information in a different code.

transmitter. 1: A device for transmitting a coded signal. 2: The carbon device in the telephone handset used to convert speech to electrical energy.

transparency. 1: The property of being insensitive to the meaning of a code being manipulated. An example is a paper-tape transmitter capable of transmitting any code submitted to it. If a device interprets and reacts to coded information that it is handling, it is said to be code sensitive (not transparent). 2: Clear substrates upon which images can be written, copied, or printed for projection onto a screen by an overhead projector.

transportable personal computer. The transportable personal computer is a self-contained system that can be moved from place to place as a single unit. These systems include, in a single unit, the keyboard, display, mass storage, and main system unit. Such a personal computer operates on A/C power only (no battery power).

transportation. An environment or industry that includes establishments providing, to the general public or the other business enterprises, passenger and freight transportation.

transportation electronic equipment. Electronic equipment used in the automotive railway and airline industry.

transportation management. The planning, analysis, and control of activities for transporting or being transported.

TTL. See **transistor-transistor logic.**

two-year college. A postsecondary school that offers general or liberal arts education usually leading to an associate degree or courses that are creditable toward a baccalaureate degree.

two-year institution. An institution legally authorized to offer and offering at least a two-year program of college-level studies that terminates in an associate degree or is principally creditable toward a baccalaureate degree.

typewriter. A machine for writing in characters by means of a keyboard operated by striking through an inked ribbon. Usually refers to the standard office typewriter (mechanical, electrical, or electronic).

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U

UART/USART. See **universal asynchronous receiver/transmitter/universal synchronous asynchronous receiver/transmitter.**

ultrasonic cleaners, drills. 1: An instrument used to clean debris and swarf from surfaces by immersion in a solvent in which ultrasonic vibrations are excited. 2: A drill in which ultrasonic vibrations are generated by the compression and extension of a core electrostrictive or magnetostrictive material.

ultrasonic generator. A generator consisting of an oscillator driving an electracoustic transducer used to produce acoustic waves.

ultrasonic scanner, medical. A device that produces a picture display of ultrasonic frequency waves sent through the sample to be inspected or examined.

ultraviolet electrically programmable ROM. An EPROM that is erasable with an ultraviolet light source.

unit. A single quantity.

universal asynchronous receiver/transmitter/universal synchronous asynchronous receiver/transmitter (UART/USART). An electronic circuit that converts data between the parallel format and the serial format transmitted sequentially over a communication line.

UNIX. An operating system designed to be used with microprocessors and with the C programming language.

useful life. The economic life of a product. Typically used to determine depreciation and leasing schedules.

user interface. 1: The point at which a user interacts with a computer. 2: An interactive computer program that sends messages to and receives instructions from a terminal user.

users per system. The typical number of simultaneous users that a computer system will support.

utilities. An environment or industry that includes establishments providing electricity, gas, steam, water, or sanitary services to the general public or to other business enterprises.

UV EPROM. See **ultraviolet electrically programmable ROM.**

V

vacuum column tape drive. A 1/2-inch reel-to-reel tape drive with start-stop capability that uses vacuum columns to provide tape tension and buffing.

value-added network (VAN). A data communication network that provides enhanced services such as protocol conversion.

value-added reseller (VAR) systems integrator. A product reseller that integrates hardware, software, and/or services; it does not apply its label to the product. Systems integrators are a type of VAR and may or may not own the hardware or software.

VAN. See **value-added network.**

VAR. See **value-added reseller systems integrator.**

VAX/VMS. A Digital Equipment Corporation standard multiuser operating system.

VCR. See **videocassette recorder and player.**

vertical-turning programmable machine tool. The tool of a machine that holds a workpiece along the vertical axis for a certain function to be performed such as boring, drilling, and cutting.

vibrational. The effects of vibration and shock on the system.

video. 1: Relates to the bandwidth (megahertz) and spectrum position of the signal arising from television scanning. 2: The reception or recording of electronic signals that create images on a screen or display.

video camera. A camera that records visual images and sounds on magnetic tape.

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videocassette recorder and player (VCRs or VTRs). A complete system that has a tape format such as beta, VHS, or 8mm.

videodisc player. A complete video system that has a disc format.

video equipment. Equipment includes amplifiers, television cameras, and other equipment such as synchronization equipment, live cameras, and control consoles.

video home system (VHS) helical scan tape drive. A 13mm helical scan tape drive commonly used for recording television broadcasts.

videotex. An information delivery system that uses information from a database that allows the user to interact with the service, selecting information to be displayed on the user's CRT providing financial services, electronic mail, and teleshopping.

virtual private network (VPN). Similar in function to a leased circuit with the exception that the circuit is not dedicated to one customer.

VLSI. Very large scale integration.

VMS. See **voice-messaging system.**

voice-messaging system (VMS). A computer-based system that enables flexible, nonsimultaneous voice communications. This definition does not include personal-computer-board-level products.

voice-recognition computer device. The capability of a computer to recognize spoken commands. Each user must first "train" the computer by speaking a series of words that the computer can analyze and match with stored information.

voice response unit (VRU). A computer-connected device that selectively links sentences of stored words, creating a spoken word.

voice synthesizer. A device that simulates speech by assembling a language's elements under digital control.

voice terminal. See **telephone.**

voltage regulator and reference IC. 1: A device that provides power to other circuits at a specified DC voltage. 2: A device that provides a specified constant DC voltage to a load over a wide range of variations in input voltage and output current.

VPN. See **virtual private network.**

VRU. See **voice response unit.**

VTR. See **videocassette recorder and player.**

W

wafer. A thin (10 to 20 mils) disk of semiconductor material from which semiconductors are fabricated.

wafer fab. The integrated circuit production process—from raw wafers through a series of diffusion, etching, photolithographic, and other steps to finished wafers.

wafer fabrication equipment. Machinery used to produce wafers in the semiconductor industry. (See also **e-beam, etch-and-clean equipment, stepper.**)

wafer inspection. Inspection of patterned wafers for process defects by visual and image-processing techniques.

water quality and sewage control. A real-time software application that monitors and controls water quality and sewage.

WATS. See **wide area telephone service.**

web ribbon. Web or towel ribbons are wide ribbons used on line, dot matrix, and line, fully formed printers. They are as wide as the print line is long—usually approximately 15 inches.

wet chemical. A chemical used in semiconductor wafer fabrication. Examples are acids and solvents.

wet etch. Immersing method for wafers in an etching solution. Chemical removal of a material by bathing the wafer in acid.

white-collar worker. A person working in an occupation classified by the Bureau of Labor Statistics under the following category headings: managerial and professional specialty and technical, sales, and administrative support.

wholesale trade. An environment or industry that includes establishments or places of business primarily engaged in selling merchandise to retailers; to industrial, commercial, institutional, farm, construction contractors, or professional business users; or to other wholesalers; or acting as agents or brokers in buying merchandise for or selling merchandise to such persons or companies.

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wide area telephone service. An enhanced telephone company service allowing reduced costs of certain telephone call arrangements. This service can be in-wats or 800-number service (calls can be placed to a location from anywhere at no cost to the calling party) or out-wats (calls can be placed out from a central location).

word processing. A software application with the principal function of editing, entering, and formatting text.

word processor (WP). A standalone word processor capable of functioning independently from a central controller or storage device, although they may communicate with each other. These products generally have removable magnetic media. Products that have evolved from electronic typewriters generally are not included in this category. The ability to share a printer among workstations does not disqualify a product from being a standalone word processor; shared-system word processors are connected to an external file server or controller; word-processor file servers are centralized data storage devices that are accessible and dedicated to shared word processing units.

work force. All persons of either sex who furnish the supply of labor for the production of economic goods and services during a specified time period.

workstation computer. A single-user computer that is distinguished from a personal computer by its features and by the user's potential migration path within the platform. A technical workstation is a system designed with integrated networking; high-performance graphics; floating point; coprocessor; and a virtual, multiuser/multitasking operating system (DOMAIN, UNIX, VMS).

WORM. See **write-once/read-many.**

WP. See **word processor.**

write-once/read-many (WORM). 1: The WORM optical disk market includes drives that can read and write data using various optical diskette media. 2: A data storage device using laser technology that uses a removable disk ranging in size from 3.5 to 14 inches.

X

X-ray (lithography). A machine that uses an X ray for generating a mask plate of direct image transfer to a semiconductor wafer.

X-ray, medical. Equipment used to detect, examine, treat, or analyze body systems through photographic X-rays.

X.25. A CCITT standard that defines the interface between a public data network and a packet-mode user device; also defines the services that these user devices can expect from the X.25 public data network.

Y

year-average population. The installed base of a product computed at the midyear between the beginning installed base and the ending installed base of the same year.

Z

zener diode. 1: A diode that has a controlled, reverse-voltage/current relationship. 2: A two-layer device that has a sudden rise in current above a certain reverse voltage.

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• Market Statistics

Dataquest

Semiconductor Consumption and Shipment Forecast

October 1991

Source:
Dataquest

Dataquest

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Semiconductor Consumption and Shipment Forecast

Introduction

Semiconductor consumption and shipment data comprise a set of detailed tables that estimate the size of the semiconductor total available market (TAM) worldwide and for four major geographical regions for 1985 through 1995. Semiconductor consumption and shipment tables contain both historical data and forecasts. Historical data begin with 1985 and end with 1990, while forecast data provide annual market size estimates for 1991 through 1995. The following list of tables details the type of data, region, time period, and units of measure.

Each table gives estimates of semiconductor revenue or shipments listed by the major semiconductor device product categories. In these tables, semiconductor components are divided into three major product groups: integrated circuits, discrete devices, and optoelectronic devices. These groups are divided into a number of subgroups, some of which are segmented further.

Definitions and Conventions

Dataquest uses a common manufacturer base for all data tables. This base includes all suppliers to the merchant semiconductor market. It includes aggregate revenue estimates for North American companies that manufacture devices solely for the benefit of the parent company, such as Delco, IBM, and Unisys. Also included are companies that actively market semiconductor devices to the merchant market as well as to other divisions of their own companies. For such companies, both external and internal shipments are included. Devices that are used internally are valued at current market prices.

Consumption—Dataquest defines consumption as the purchase of a semiconductor device or

List of Tables

Table	Region Covered	Years	Units
0	Japanese and Western European Exchange Rates	1970-1989	Various
1a	Worldwide Market	1985-1990	Dollars
1b	Worldwide Market	1985-1990	Percent
1c	Worldwide Market	1991-1995	Dollars
1d	Worldwide Market	1991-1995	Percent
2a	North American Market	1985-1990	Dollars
2b	North American Market	1985-1990	Percent
2c	North American Market	1991-1995	Dollars
2d	North American Market	1991-1995	Percent
3a	Japanese Market	1985-1990	Dollars
3b	Japanese Market	1985-1990	Percent
3c	Japanese Market	1991-1995	Dollars
3d	Japanese Market	1991-1995	Percent
4a	Japanese Market	1985-1990	Yen
4b	Japanese Market	1985-1990	Percent
4c	Japanese Market	1991-1995	Yen
4d	Japanese Market	1991-1995	Percent

(Continued)

List of Tables (Continued)

Table	Region Covered	Years	Units
5a	Western European Market	1985-1990	Dollars
5b	Western European Market	1985-1990	Percent
5c	Western European Market	1991-1995	Dollars
5d	Western European Market	1991-1995	Percent
6a	Asia/Pacific-ROW Market	1985-1990	Dollars
6b	Asia/Pacific-ROW Market	1985-1990	Percent
6c	Asia/Pacific-ROW Market	1991-1995	Dollars
6d	Asia/Pacific-ROW Market	1991-1995	Percent

devices. This definition must be differentiated from actual use of the device in a final product. A regional market size includes all devices sold to or within, or shipped to or within, that region (i.e., the TAM of that region).

Hybrids—In earlier consumption data, hybrid devices were included as a separate segment of integrated circuits. Hybrid devices manufactured by semiconductor companies are now included in the most appropriate product segment, usually the analog segment.

The manufacturer base, product group definitions, and guidelines for including value of output that we have used in our tables may differ from those used in other studies of this type. Our base is nearly the same as that used by the World Semiconductor Trade Statistics (WSTS) program, with the following exceptions:

- Dataquest includes all of AT&T's semiconductor revenue, both merchant and captive.
- Dataquest includes—and has always included—nonrecurring engineering (NRE) charges associated with application-specific integrated circuit (ASIC) revenue. (This applies to both the bipolar digital and MOS digital logic categories.)
- Dataquest includes the revenue generated by sales of standalone circuit design software, sold by certain U.S. manufacturers of ASIC logic devices.
- Dataquest includes Signetics revenue with that of its parent company, Netherlands-based N.V. Philips.
- Dataquest includes revenue for Taiwanese semiconductor manufacturers.
- Dataquest includes revenue for three Japanese companies not included by WSTS until 1990: NMB Semiconductor, Seiko-Epson, and Yamaha.
- As noted herein, Dataquest includes hybrid revenue in the analog category.

Regions—North America is defined as including both the United States and Canada. Latin America, including Mexico, is considered part of the Asia/Pacific-ROW category. Asia/Pacific includes South Korea, Taiwan, Hong Kong, Singapore, and China. Western Europe includes Austria, Belgium, Germany, France, Italy, Luxembourg, the Netherlands, the Scandinavian countries (Denmark, Finland, Norway, Sweden), Spain, the United Kingdom, and the rest of Europe. Japan, the fourth region, is the only single-country region.

Data Sources

The historical information presented in the consumption and shipment data has been consolidated from a variety of sources, each of which focuses on a specific part of the market. These sources include the following:

- WSTS data and Dataquest's estimates of regional company sales are used to determine shipments to North America.
- Japanese trade statistics compiled and published by the Ministry of Finance (MOF) and the Ministry of International Trade and Industry (MITI), WSTS data, and Dataquest's estimates of regional company sales are used to determine shipments to Japan.

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- For Western European markets, marketing statistics from WSTS data and Dataquest's estimates of regional company sales are used to determine market size.
- In Asia/Pacific-ROW, the major published sources used to estimate market size are WSTS data and Dataquest's estimates of company shipments into the region.

Dataquest believes that the estimates presented here are the most accurate and meaningful generally available today. The sources of the data and the guidelines for the forecasts presented in the tables are as follows:

- Dataquest's own forecasts of electronic equipment production and semiconductor I/O ratios
- Unit shipments or revenue (or both) published by major industry participants, both in the United States and abroad
- Estimates presented by knowledgeable and reliable industry spokespersons
- Government data or trade association data such as those from the Electronics Industry Association (EIA), MITI, WSTS, and the U.S. Department of Commerce
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users
- Relevant projected world economic data

Accuracy

The tables presented here represent Dataquest estimates that we believe are reasonably accurate. Where we have no reasonable estimate, none is given. A zero in a table represents an estimate.

Valuation of Consumption

Regional market size is expressed in U.S. dollars (with the Japanese market also expressed in yen). To make the tables in this study useful in comparing different regions, it is necessary to express all values in a common currency, and we chose the U.S. dollar for convenience. However, the choice of the U.S. dollar (or any single currency, for that matter) as the currency basis for the tables brings with it some problems that require the readers' careful consideration in interpreting the data.

Inflation

All countries that participate significantly in international semiconductor markets suffered from an overall price inflation in the 1980s, continuing into the 1990s. As a consequence, the dollar in a given year is not truly comparable with the dollar in any preceding year. Consumer and wholesale price indices and GNP deflators all measure price changes in various composite "market baskets" of goods. However, there is no price index that measures price changes of material, equipment, and labor inputs to the semiconductor industry. Indeed, the "mix" is changing so rapidly that what is used this year was sometimes unavailable last year, at any price. Nor is there a composite price index that measures price changes in aggregate semiconductor product. In an industry noted for its deflationary trends, this latter effect would tend to make the component purchaser's dollar worth more as time passed, in terms of purchasing ability.

We have made no adjustments in the historical data to account for these inflationary and deflationary effects. The data are expressed in current dollars (dollars that include the inflation rate and exchange rates of the given year) for all historical data; comparisons between different years must be interpreted accordingly.

Exchange Rates

Construction of the West European tables involves combining data from many countries, each of which has different and changing exchange rates. Dataquest uses Annual Foreign Exchange Rates for each year as published by The International Monetary Fund and *The Wall Street Journal*. As far as possible, we prepare our estimates in terms of local currencies before conversion to U.S. dollars. The exchange rates for major currencies can be found in Table 0 at the end of this introduction.

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Japanese market size is originally expressed in yen. The Japanese data published in this study are expressed in both dollars (Tables 3a, 3b, 3c, and 3d) and in yen (Tables 4a, 4b, 4c, and 4d). The yen/dollar exchange rate used for each year can be found in the table below. Because of the fluctuations in the exchange rate for the yen, the dollar values given tend to distort the growth rate of the Japanese market, but they do provide a useful basis for regional market size comparisons. However, the data in yen give a better picture of the real growth in the Japanese market.

Forecast

As mentioned previously, historical data are expressed in current dollars or dollars that include the given year's inflation rate and exchange rates. However, the revenue forecasts use constant dollars and exchange rates, with no allowance for inflation or variations in the rates of exchange between countries. All estimates for 1991 and beyond are made as if 1991 monetary conditions will continue through 1995 and, therefore, show the absolute year-to-year growth during this period.

Table 0
Foreign Exchange Rates

Year	Yrly/Qtrly	Japan (Yen per U.S.$)	France (U.S.$ per Franc)	Germany (U.S.$ per Deutsche Mark)	United Kingdom (U.S.$ per Pound Sterling)
1970	YR	358	0.18	0.27	2.38
1971	YR	343	0.18	0.29	2.44
1972	YR	302	0.20	0.31	2.50
1973	YR	269	0.22	0.37	2.44
1974	YR	292	0.21	0.39	2.33
1975	YR	297	0.23	0.41	2.22
1976	YR	296	0.21	0.40	1.82
1977	YR	269	0.20	0.43	1.75
1978	YR	210	0.22	0.50	1.92
1979	YR	219	0.24	0.55	2.13
1980	YR	227	0.24	0.55	2.33
1981	YR	221	0.18	0.44	2.04
1982	YR	248	0.15	0.41	1.75
1983	YR	235	0.13	0.39	1.52
1984	YR	237	0.11	0.35	1.33
1985	YR	238	0.11	0.34	1.30
1986	YR	167	0.14	0.46	1.47
1987	YR	144	0.17	0.56	1.64
1988	YR	130	0.17	0.57	1.79
1989	YR	138	0.16	0.53	1.50
1990	YR	144	0.18	0.62	1.79
Q191	QTR	134	0.19	0.65	1.91
Q291	QTR	138	0.17	0.58	1.70

Source: The International Monetary Fund, *Financial Times*, Dataquest (October 1991)

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Table 1a
Worldwide Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	27,116	33,729	41,478	54,521	61,454	62,772
North American Captives	2,773	2,895	3,227	3,662	4,241	4,547
Total Semiconductor	24,343	30,834	38,251	50,859	57,213	58,225
Total IC	18,552	23,618	29,887	41,068	46,924	47,303
Bipolar Digital	3,684	4,325	4,760	5,200	4,510	4,440
Memory	589	606	621	689	540	459
Logic	3,095	3,719	4,139	4,511	3,970	3,981
MOS Digital	10,103	12,815	17,473	26,988	33,024	32,292
Memory	3,817	4,511	6,056	11,692	16,361	13,091
Micro	2,745	3,489	5,108	7,144	8,202	10,068
Logic	3,541	4,815	6,309	8,152	8,461	9,133
Analog	4,765	6,478	7,654	8,880	9,390	10,571
Total Discrete	4,578	5,730	6,655	7,612	7,662	8,235
Total Optoelectronic	1,213	1,486	1,709	2,179	2,627	2,687

Source: Dataquest (October 1991)

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Table 1b
Worldwide Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-13.4	24.4	23.0	31.4	12.7	2.1	18.3
North American Captives	10.9	4.4	11.5	13.5	15.8	7.2	10.4
Total Semiconductor	-15.5	26.7	24.1	33.0	12.5	1.8	19.1
Total IC	-18.0	27.3	26.5	37.4	14.3	.8	20.6
Bipolar Digital	-23.0	17.4	10.1	9.2	-13.3	-1.6	3.8
Memory	-23.9	2.9	2.5	11.0	-21.6	-15.0	-4.9
Logic	-22.8	20.2	11.3	9.0	-12.0	.3	5.2
MOS Digital	-22.0	26.8	36.3	54.5	22.4	-2.2	26.2
Memory	-38.7	18.2	34.2	93.1	39.9	-20.0	28.0
Micro	-15.0	27.1	46.4	39.9	14.8	22.8	29.7
Logic	1.4	36.0	31.0	29.2	3.8	7.9	20.9
Analog	-2.5	35.9	18.2	16.0	5.7	12.6	17.3
Total Discrete	-8.2	25.2	16.1	14.4	.7	7.5	12.5
Total Optoelectronic	-.7	22.5	15.0	27.5	20.6	2.3	17.2

Source: Dataquest (October 1991)

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Table 1c
Worldwide Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995
Total Including Captives	69,232	78,767	91,055	102,193	110,352
North American Captives	5,584	6,556	7,518	8,407	8,691
Total Semiconductor	63,648	72,211	83,537	93,786	101,661
Total IC	51,863	59,672	69,840	79,106	86,141
Bipolar Digital	4,095	3,966	3,843	3,637	3,390
Memory	414	407	407	378	352
Logic	3,681	3,559	3,436	3,259	3,038
MOS Digital	35,926	42,496	50,980	58,661	64,546
Memory	13,418	15,958	19,378	22,583	24,447
Micro	12,063	14,494	17,465	19,982	22,216
Logic	10,445	12,044	14,137	16,096	17,883
Analog	11,842	13,210	15,017	16,808	18,205
Total Discrete	8,777	9,241	10,040	10,656	11,172
Total Optoelectronic	3,008	3,298	3,657	4,024	4,348

Source: Dataquest (October 1991)

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Table 1d
Worldwide Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95
Total Including Captives	10.3	13.8	15.6	12.2	8.0	11.9
North American Captives	22.8	17.4	14.7	11.8	3.4	13.8
Total Semiconductor	9.3	13.5	15.7	12.3	8.4	11.8
Total IC	9.6	15.1	17.0	13.3	8.9	12.7
Bipolar Digital	-7.8	-3.2	-3.1	-5.4	-6.8	-5.3
Memory	-9.8	-1.7	0	-7.1	-6.9	-5.2
Logic	-7.5	-3.3	-3.5	-5.2	-6.8	-5.3
MOS Digital	11.3	18.3	20.0	15.1	10.0	14.9
Memory	2.5	18.9	21.4	16.5	8.3	13.3
Micro	19.8	20.2	20.5	14.4	11.2	17.2
Logic	14.4	15.3	17.4	13.9	11.1	14.4
Analog	12.0	11.6	13.7	11.9	8.3	11.5
Total Discrete	6.6	5.3	8.6	6.1	4.8	6.3
Total Optoelectronic	11.9	9.6	10.9	10.0	8.1	10.1

Source: Dataquest (October 1991)

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Table 2a
North American Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	11,663	13,171	15,454	18,789	21,348	20,844
North American Captives	2,243	2,327	2,596	2,945	3,411	3,458
Total Semiconductor	9,420	10,844	12,858	15,844	17,937	17,386
Total IC	7,757	8,986	10,886	13,815	15,909	15,387
Bipolar Digital	1,926	2,030	2,099	2,012	1,701	1,652
Memory	288	267	271	235	203	170
Logic	1,638	1,763	1,828	1,777	1,498	1,482
MOS Digital	4,322	4,912	6,738	9,606	11,682	11,025
Memory	1,753	1,775	2,497	4,298	6,163	4,655
Micro	1,258	1,362	2,012	2,707	2,972	3,563
Logic	1,311	1,775	2,229	2,601	2,547	2,807
Analog	1,509	2,044	2,049	2,197	2,526	2,710
Total Discrete	1,295	1,542	1,642	1,676	1,683	1,669
Total Optoelectronic	368	316	330	353	345	330

Source: Dataquest (October 1991)

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Table 2b
North American Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-22.4	12.9	17.3	21.6	13.6	-2.4	12.3
North American Captives	10.7	3.7	11.6	13.4	15.8	1.4	9.0
Total Semiconductor	-27.6	15.1	18.6	23.2	13.2	-3.1	13.0
Total IC	-30.0	15.8	21.1	26.9	15.2	-3.3	14.7
Bipolar Digital	-31.7	5.4	3.4	-4.1	-15.5	-2.9	-3.0
Memory	-34.7	-7.3	1.5	-13.3	-13.6	-16.3	-10.0
Logic	-31.1	7.6	3.7	-2.8	-15.7	-1.1	-2.0
MOS Digital	-33.5	13.7	37.2	42.6	21.6	-5.6	20.6
Memory	-48.8	1.3	40.7	72.1	43.4	-24.5	21.6
Micro	-23.0	8.3	47.7	34.5	9.8	19.9	23.1
Logic	-9.1	35.4	25.6	16.7	-2.1	10.2	16.4
Analog	-14.6	35.5	.2	7.2	15.0	7.3	12.4
Total Discrete	-13.8	19.1	6.5	2.1	.4	-.8	5.2
Total Optoelectronic	-11.1	-14.1	4.4	7.0	-2.3	-4.3	-2.2

Source: Dataquest (October 1991)

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Table 2c
North American Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995
Total Including Captives	22,640	25,577	29,421	32,975	35,263
North American Captives	4,157	4,849	5,533	6,217	6,447
Total Semiconductor	18,483	20,728	23,888	26,758	28,816
Total IC	16,414	18,540	21,482	24,184	26,141
Bipolar Digital	1,411	1,305	1,279	1,194	1,094
Memory	149	138	134	118	104
Logic	1,262	1,167	1,145	1,076	990
MOS Digital	12,077	13,915	16,402	18,746	20,432
Memory	4,966	5,652	6,736	7,840	8,397
Micro	4,003	4,784	5,613	6,326	6,952
Logic	3,108	3,479	4,053	4,580	5,083
Analog	2,926	3,320	3,801	4,244	4,615
Total Discrete	1,733	1,823	2,014	2,157	2,237
Total Optoelectronic	336	365	392	417	438

Source: Dataquest (October 1991)

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Table 2d
North American Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95
Total Including Captives	8.6	13.0	15.0	12.1	6.9	11.1
North American Captives	20.2	16.6	14.1	12.4	3.7	13.3
Total Semiconductor	6.3	12.1	15.2	12.0	7.7	10.6
Total IC	6.7	13.0	15.9	12.6	8.1	11.2
Bipolar Digital	-14.6	-7.5	-2.0	-6.6	-8.4	-7.9
Memory	-12.4	-7.4	-2.9	-11.9	-11.9	-9.4
Logic	-14.8	-7.5	-1.9	-6.0	-8.0	-7.8
MOS Digital	9.5	15.2	17.9	14.3	9.0	13.1
Memory	6.7	13.8	19.2	16.4	7.1	12.5
Micro	12.3	19.5	17.3	12.7	9.9	14.3
Logic	10.7	11.9	16.5	13.0	11.0	12.6
Analog	8.0	13.5	14.5	11.7	8.7	11.2
Total Discrete	3.8	5.2	10.5	7.1	3.7	6.0
Total Optoelectronic	1.8	8.6	7.4	6.4	5.0	5.8

Source: Dataquest (October 1991)

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Table 3a
Japanese Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	8,300	12,018	15,107	20,977	23,234	23,031
North American Captives	151	163	180	205	237	523
Total Semiconductor	8,149	11,855	14,927	20,772	22,997	22,508
Total IC	5,985	8,802	11,263	16,127	17,946	17,387
Bipolar Digital	824	1,295	1,523	1,906	1,750	1,800
Memory	136	169	227	348	246	209
Logic	688	1,126	1,296	1,558	1,504	1,591
MOS Digital	3,232	4,762	6,424	10,501	12,497	11,799
Memory	1,185	1,738	2,268	4,424	5,992	4,612
Micro	884	1,368	1,902	2,573	2,828	3,210
Logic	1,163	1,656	2,254	3,504	3,677	3,977
Analog	1,929	2,745	3,316	3,720	3,699	3,788
Total Discrete	1,621	2,242	2,693	3,282	3,321	3,392
Total Optoelectronic	543	811	971	1,363	1,730	1,729

Source: Dataquest (October 1991)

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Table 3b
Japanese Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-6.8	44.8	25.7	38.9	10.8	-.9	22.6
North American Captives	11.9	7.9	10.4	13.9	15.6	120.7	28.2
Total Semiconductor	-7.1	45.5	25.9	39.2	10.7	-2.1	22.5
Total IC	-8.2	47.1	28.0	43.2	11.3	-3.1	23.8
Bipolar Digital	-13.7	57.2	17.6	25.1	-8.2	2.9	16.9
Memory	-16.6	24.3	34.3	53.3	-29.3	-15.0	9.0
Logic	-13.1	63.7	15.1	20.2	-3.5	5.8	18.3
MOS Digital	-10.7	47.3	34.9	63.5	19.0	-5.6	29.6
Memory	-25.0	46.7	30.5	95.1	35.4	-23.0	31.2
Micro	-9.7	54.8	39.0	35.3	9.9	13.5	29.4
Logic	9.4	42.4	36.1	55.5	4.9	8.2	27.9
Analog	-.6	42.3	20.8	12.2	-.6	2.4	14.4
Total Discrete	-7.7	38.3	20.1	21.9	1.2	2.1	15.9
Total Optoelectronic	8.4	49.4	19.7	40.4	26.9	-.1	26.1

Source: Dataquest (October 1991)

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Table 3c
Japanese Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995
Total Including Captives	26,215	30,342	34,272	38,216	41,257
North American Captives	671	818	931	1,008	1,025
Total Semiconductor	25,544	29,524	33,341	37,208	40,232
Total IC	19,645	23,089	26,385	29,724	32,224
Bipolar Digital	1,794	1,865	1,819	1,757	1,681
Memory	204	220	225	221	217
Logic	1,590	1,645	1,594	1,536	1,464
MOS Digital	13,391	16,260	19,131	22,090	24,347
Memory	4,581	5,731	6,884	8,112	8,695
Micro	4,008	4,855	5,725	6,561	7,391
Logic	4,802	5,674	6,522	7,417	8,261
Analog	4,460	4,964	5,435	5,877	6,196
Total Discrete	3,849	4,138	4,420	4,694	4,964
Total Optoelectronic	2,050	2,297	2,536	2,790	3,044

Source: Dataquest (October 1991)

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Table 3d
Japanese Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95
Total Including Captives	13.8	15.7	13.0	11.5	8.0	12.4
North American Captives	28.3	21.9	13.8	8.3	1.7	14.4
Total Semiconductor	13.5	15.6	12.9	11.6	8.1	12.3
Total IC	13.0	17.5	14.3	12.7	8.4	13.1
Bipolar Digital	-.3	4.0	-2.5	-3.4	-4.3	-1.4
Memory	-2.4	7.8	2.3	-1.8	-1.8	.8
Logic	-.1	3.5	-3.1	-3.6	-4.7	-1.7
MOS Digital	13.5	21.4	17.7	15.5	10.2	15.6
Memory	-.7	25.1	20.1	17.8	7.2	13.5
Micro	24.9	21.1	17.9	14.6	12.7	18.2
Logic	20.7	18.2	14.9	13.7	11.4	15.7
Analog	17.7	11.3	9.5	8.1	5.4	10.3
Total Discrete	13.5	7.5	6.8	6.2	5.8	7.9
Total Optoelectronic	18.6	12.0	10.4	10.0	9.1	12.0

Source: Dataquest (October 1991)

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Table 4a
Japanese Semiconductor Consumption
(Factory Revenue in Billions of Japanese Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	1,975.3	2,006.9	2,175.4	2,727.0	3,206.3	3,316.4
North American Captives	35.9	27.2	25.9	26.7	32.7	75.3
Total Semiconductor	1,939.4	1,979.7	2,149.5	2,700.3	3,173.6	3,241.1
Total IC	1,424.4	1,469.9	1,621.9	2,096.4	2,476.6	2,503.7
Bipolar Digital	196.1	216.2	219.3	247.7	241.5	259.2
Memory	32.4	28.2	32.7	45.2	33.9	30.1
Logic	163.7	188.0	186.6	202.5	207.6	229.1
MOS Digital	769.2	795.3	925.1	1,365.1	1,724.6	1,699.0
Memory	282.0	290.2	326.6	575.1	826.9	664.1
Micro	210.4	228.5	273.9	334.5	390.3	462.2
Logic	276.8	276.6	324.6	455.5	507.4	572.7
Analog	459.1	458.4	477.5	483.6	510.5	545.5
Total Discrete	385.8	374.4	387.8	426.7	458.3	488.4
Total Optoelectronic	129.2	135.4	139.8	177.2	238.7	249.0
Exchange Rate (Yen/U.S.$)	238	167	144	130	138	144

Source: Dataquest (October 1991)

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Table 4b
Japanese Semiconductor Consumption
(Percent Change in Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-6.4	1.6	8.4	25.4	17.6	3.4	10.9
North American Captives	0	0	0	0	0	0	0
Total Semiconductor	-6.7	2.1	8.6	25.6	17.5	2.1	10.8
Total IC	-7.8	3.2	10.3	29.3	18.1	1.1	11.9
Bipolar Digital	-13.3	10.2	1.4	13.0	-2.5	7.3	5.7
Memory	-16.1	-13.0	16.0	38.2	-25.0	-11.2	-1.5
Logic	-12.8	14.8	-.7	8.5	2.5	10.4	7.0
MOS Digital	-10.4	3.4	16.3	47.6	26.3	-1.5	17.2
Memory	-24.6	2.9	12.5	76.1	43.8	-19.7	18.7
Micro	-9.3	8.6	19.9	22.1	16.7	18.4	17.0
Logic	9.9	-.1	17.4	40.3	11.4	12.9	15.7
Analog	-.2	-.2	4.2	1.3	5.6	6.9	3.5
Total Discrete	-7.3	-3.0	3.6	10.0	7.4	6.6	4.8
Total Optoelectronic	8.8	4.8	3.2	26.8	34.7	4.3	14.0

Source: Dataquest (October 1991)

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Table 4c
Japanese Semiconductor Consumption
(Factory Revenue in Billions of Japanese Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995
Total Including Captives	3,592.8	4,187.2	4,729.8	5,273.8	5,693.3
North American Captives	92.0	112.9	128.5	139.1	141.4
Total Semiconductor	3,500.8	4,074.3	4,601.3	5,134.7	5,551.9
Total IC	2,692.3	3,186.3	3,641.3	4,101.9	4,446.8
Bipolar Digital	245.9	257.4	251.1	242.5	231.9
Memory	28.0	30.4	31.1	30.5	29.9
Logic	217.9	227.0	220.0	212.0	202.0
MOS Digital	1,835.2	2,243.9	2,640.2	3,048.4	3,359.9
Memory	627.8	790.9	950.0	1,119.5	1,199.9
Micro	549.3	670.0	790.1	905.4	1,020.0
Logic	658.1	783.0	900.1	1,023.5	1,140.0
Analog	611.2	685.0	750.0	811.0	855.0
Total Discrete	527.5	571.0	610.0	647.8	685.0
Total Optoelectronic	281.0	317.0	350.0	385.0	420.1
Exchange Rate (Yen/U.S.$)	137.0	138.0	138.0	138.0	138.0

Source: Dataquest (October 1991)

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Table 4d
Japanese Semiconductor Consumption
(Percent Change in Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95
Total Including Captives	8.3	16.5	13.0	11.5	8.0	11.4
North American Captives	0	0	0	0	0	0
Total Semiconductor	8.0	16.4	12.9	11.6	8.1	11.4
Total IC	7.5	18.3	14.3	12.6	8.4	12.2
Bipolar Digital	-5.1	4.7	-2.4	-3.4	-4.4	-2.2
Memory	-7.0	8.6	2.3	-1.9	-2.0	-.1
Logic	-4.9	4.2	-3.1	-3.6	-4.7	-2.5
MOS Digital	8.0	22.3	17.7	15.5	10.2	14.6
Memory	-5.5	26.0	20.1	17.8	7.2	12.6
Micro	18.8	22.0	17.9	14.6	12.7	17.2
Logic	14.9	19.0	15.0	13.7	11.4	14.8
Analog	12.0	12.1	9.5	8.1	5.4	9.4
Total Discrete	8.0	8.2	6.8	6.2	5.7	7.0
Total Optoelectronic	12.9	12.8	10.4	10.0	9.1	11.0

Source: Dataquest (October 1991)

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Table 5a
European Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	5,174	5,992	6,949	9,003	10,348	11,227
North American Captives	379	405	451	512	593	566
Total Semiconductor	4,795	5,587	6,498	8,491	9,755	10,661
Total IC	3,615	4,116	4,840	6,669	7,794	8,326
Bipolar Digital	719	719	727	772	640	577
Memory	150	147	88	74	72	58
Logic	569	572	639	698	568	519
MOS Digital	1,933	2,270	2,761	4,364	5,458	5,403
Memory	745	813	854	1,797	2,548	2,154
Micro	486	574	805	1,212	1,469	1,836
Logic	702	883	1,102	1,355	1,441	1,413
Analog	963	1,127	1,352	1,533	1,696	2,346
Total Discrete	969	1,207	1,377	1,516	1,594	1,915
Total Optoelectronic	211	264	281	306	367	420

Source: Dataquest (October 1991)

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Table 5b
European Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-.5	15.8	16.0	29.6	14.9	8.5	16.8
North American Captives	12.1	6.9	11.4	13.5	15.8	-4.6	8.4
Total Semiconductor	-1.4	16.5	16.3	30.7	14.9	9.3	17.3
Total IC	-3.1	13.9	17.6	37.8	16.9	6.8	18.2
Bipolar Digital	-3.0	0	1.1	6.2	-17.1	-9.8	-4.3
Memory	4.2	-2.0	-40.1	-15.9	-2.7	-19.4	-17.3
Logic	-4.7	.5	11.7	9.2	-18.6	-8.6	-1.8
MOS Digital	-8.9	17.4	21.6	58.1	25.1	-1.0	22.8
Memory	-24.4	9.1	5.0	110.4	41.8	-15.5	23.7
Micro	3.2	18.1	40.2	50.6	21.2	25.0	30.5
Logic	5.4	25.8	24.8	23.0	6.3	-1.9	15.0
Analog	11.1	17.0	20.0	13.4	10.6	38.3	19.5
Total Discrete	2.9	24.6	14.1	10.1	5.1	20.1	14.6
Total Optoelectronic	10.5	25.1	6.4	8.9	19.9	14.4	14.8

Source: Dataquest (October 1991)

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Table 5c
European Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995
Total Including Captives	11,585	12,443	14,830	16,516	17,586
North American Captives	756	889	1,054	1,182	1,219
Total Semiconductor	10,829	11,554	13,776	15,334	16,367
Total IC	8,682	9,475	11,474	12,896	13,846
Bipolar Digital	489	424	395	361	317
Memory	49	40	40	32	25
Logic	440	384	355	329	292
MOS Digital	5,774	6,594	8,303	9,454	10,262
Memory	2,093	2,445	3,204	3,604	3,832
Micro	2,218	2,528	3,085	3,532	3,885
Logic	1,463	1,621	2,014	2,318	2,545
Analog	2,419	2,457	2,776	3,081	3,267
Total Discrete	1,751	1,682	1,864	1,954	2,013
Total Optoelectronic	396	397	438	484	508

Source: Dataquest (October 1991)

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Table 5d
European Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95
Total Including Captives	3.2	7.4	19.2	11.4	6.5	9.4
North American Captives	33.6	17.6	18.6	12.1	3.1	16.6
Total Semiconductor	1.6	6.7	19.2	11.3	6.7	9.0
Total IC	4.3	9.1	21.1	12.4	7.4	10.7
Bipolar Digital	-15.3	-13.3	-6.8	-8.6	-12.2	-11.3
Memory	-15.5	-18.4	0	-20.0	-21.9	-15.5
Logic	-15.2	-12.7	-7.6	-7.3	-11.2	-10.9
MOS Digital	6.9	14.2	25.9	13.9	8.5	13.7
Memory	-2.8	16.8	31.0	12.5	6.3	12.2
Micro	20.8	14.0	22.0	14.5	10.0	16.2
Logic	3.5	10.8	24.2	15.1	9.8	12.5
Analog	3.1	1.6	13.0	11.0	6.0	6.8
Total Discrete	-8.6	-3.9	10.8	4.8	3.0	1.0
Total Optoelectronic	-5.7	.3	10.3	10.5	5.0	3.9

Source: Dataquest (October 1991)

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Table 6a
Asia/Pacific-Rest of World Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Asia/Pacific-ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	1,979	2,548	3,968	5,752	6,524	7,670
North American Captives	0	0	0	0	0	0
Total Semiconductor	1,979	2,548	3,968	5,752	6,524	7,670
Total IC	1,195	1,714	2,898	4,457	5,275	6,203
Bipolar Digital	215	281	411	510	419	411
Memory	15	23	35	32	19	22
Logic	200	258	376	478	400	389
MOS Digital	616	871	1,550	2,517	3,387	4,065
Memory	134	185	437	1,173	1,658	1,670
Micro	117	185	389	652	933	1,459
Logic	365	501	724	692	796	936
Analog	364	562	937	1,430	1,469	1,727
Total Discrete	693	739	943	1,138	1,064	1,259
Total Optoelectronic	91	95	127	157	185	208

Source: Dataquest (October 1991)

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Table 6b
Asia/Pacific-Rest of World Semiconductor Consumption
(Percent Change)

Company: All
Product: Each
Region of Consumption: Asia/Pacific-ROW
Distribution Channel: All
Application: All
Specification: All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-9.3	28.8	55.7	45.0	13.4	17.6	31.1
North American Captives	NM	NM	NM	NM	NM	NM	NM
Total Semiconductor	-9.3	28.8	55.7	45.0	13.4	17.6	31.1
Total IC	-6.7	43.4	69.1	53.8	18.4	17.6	39.0
Bipolar Digital	-20.1	30.7	46.3	24.1	-17.8	-1.9	13.8
Memory	-42.3	53.3	52.2	-8.6	-40.6	15.8	8.0
Logic	-17.7	29.0	45.7	27.1	-16.3	-2.8	14.2
MOS Digital	-12.0	41.4	78.0	62.4	34.6	20.0	45.8
Memory	-42.7	38.1	136.2	168.4	41.3	.7	65.6
Micro	-19.3	58.1	110.3	67.6	43.1	56.4	65.6
Logic	13.7	37.3	44.5	-4.4	15.0	17.6	20.7
Analog	16.7	54.4	66.7	52.6	2.7	17.6	36.5
Total Discrete	-11.7	6.6	27.6	20.7	-6.5	18.3	12.7
Total Optoelectronic	-20.9	4.4	33.7	23.6	17.8	12.4	18.0

NM = Not meaningful

Source: Dataquest (October 1991)

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Table 6c
Asia/Pacific-Rest of World Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Asia/Pacific-ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995
Total Including Captives	8,792	10,405	12,532	14,486	16,246
North American Captives	0	0	0	0	0
Total Semiconductor	8,792	10,405	12,532	14,486	16,246
Total IC	7,122	8,568	10,499	12,302	13,930
Bipolar Digital	401	372	350	325	298
Memory	12	9	8	7	6
Logic	389	363	342	318	292
MOS Digital	4,684	5,727	7,144	8,371	9,505
Memory	1,778	2,130	2,554	3,027	3,523
Micro	1,834	2,327	3,042	3,563	3,988
Logic	1,072	1,270	1,548	1,781	1,994
Analog	2,037	2,469	3,005	3,606	4,127
Total Discrete	1,444	1,598	1,742	1,851	1,958
Total Optoelectronic	226	239	291	333	358

Source: Dataquest (October 1991)

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Table 6d
Asia/Pacific-Rest of World Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Asia/Pacific-ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95
Total Including Captives	14.6	18.3	20.4	15.6	12.1	16.2
North American Captives	NM	NM	NM	NM	NM	NM
Total Semiconductor	14.6	18.3	20.4	15.6	12.1	16.2
Total IC	14.8	20.3	22.5	17.2	13.2	17.6
Bipolar Digital	-2.4	-7.2	-5.9	-7.1	-8.3	-6.2
Memory	-45.5	-25.0	-11.1	-12.5	-14.3	-22.9
Logic	0	-6.7	-5.8	-7.0	-8.2	-5.6
MOS Digital	15.2	22.3	24.7	17.2	13.5	18.5
Memory	6.5	19.8	19.9	18.5	16.4	16.1
Micro	25.7	26.9	30.7	17.1	11.9	22.3
Logic	14.5	18.5	21.9	15.1	12.0	16.3
Analog	18.0	21.2	21.7	20.0	14.4	19.0
Total Discrete	14.7	10.7	9.0	6.3	5.8	9.2
Total Optoelectronic	8.7	5.8	21.8	14.4	7.5	11.5

NM = Not meaningful

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Worldwide and North American Electronic Equipment Production Forecast

May 1991

Source:
Dataquest

Semiconductor Application Markets *Worldwide*

Dataquest

Worldwide and North American Electronic Equipment Production Forecast
May 1991

Source: Dataquest

Published by Dataquest Incorporated

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May 1991

Worldwide and North American Electronic Equipment Production Forecast

Introduction

Electronic equipment production is an important determinant of semiconductor market activity. This is true because semiconductor demand is derived, in part, from the underlying demand for the systems that use semiconductors. That is, the demand for semiconductors is a positive (or increasing) function of the demand for electronic systems. Therefore, the forecast of expected future electronic systems production is an essential component to assess expected future semiconductor market activity.

This booklet contains a set of detailed tables of the spring 1991 electronic equipment production forecast. Worldwide production is estimated and is segmented into four major geographic regions for the years 1988 to 1995. Production tables contain both historical data and forecasts. Historical data begin with 1988 and end with 1990, while forecast data provide estimates for 1991 through 1995. The list of tables details the type of production data by region, application market, and unit of measure.

Definitions and Conventions

The objective of analyzing electronic systems production activity is to estimate its important implications for semiconductor consumption. Therefore, generalized economic concepts such as production and consumption are tailored to best isolate these implications.

The value of production is estimated as factory revenue. Dataquest defines factory revenue as the exchange value of the commodity transaction between the original equipment manufacturer and the point of entry into distribution. In the case of a direct sale that involves no distribution—as is the case with military systems—factory revenue is equal to the final-user cost, net of sales taxes.

The value of production estimates contained in this booklet are *not* directly comparable to the estimates found in the Japanese Semiconductor Application Market service (JSAM), or the European Semiconductor Application Market service (ESAM). JSAM values production at factory cost, defined as factory revenue less the quantity, gross profit margin plus selling, general, and administrative costs. ESAM values production at final-user cost. JSAM and ESAM estimates have been converted to factory revenue to permit meaningful inter-regional production and input/output ratio comparisons and to remove changes in the value of output due to changes in distribution-channel markup that would lead to spurious changes in the input/output ratios.

Production is the value-adding process by which the factors of production (labor and capital) and material inputs are transformed into the goods and services that are desired for consumption and investment. As such, production can span both time and geography. For example, a North American-owned disk drive company may minimize its cost of production by manufacturing (i.e., consuming chips) its products in Singapore, for eventual sale in, for example, Europe. We would estimate this as Asia/Pacific-Rest of World (ROW) data storage/subsystems production, because we are interested in that portion of the production process that relates particularly to semiconductor consumption. Production would be valued as the exchange value of the transaction between the North American company's Singapore operation (which is factory revenue) and the European distributor or final user.

Production is segmented into the following regions:

- North America—This region includes the United States and Canada. Latin America, including Mexico, is considered part of the Asia/Pacific-ROW region.
- Europe—This region includes Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, the Scandinavian countries (Denmark, Finland, Norway, Sweden), Spain, the United Kingdom and Ireland, and the rest of Europe.

- Asia/Pacific-ROW—This region includes South Korea, Taiwan, Hong Kong, Singapore, China, India, and the countries of Oceania.
- Japan—The fourth region, is the only single-country region.

Electronic equipment is disaggregated into the following six semiconductor application markets. Worldwide production is further disaggregated into the designated systems groups. North America production is further disaggregated into specific types of equipment systems, as shown in Tables 4a through 4l.

- Data Processing
  - Computers
  - Data storage/subsystems
  - Terminals
  - Input/output
  - Dedicated systems
- Communications
  - Premise telecom equipment
  - Public telecommunications
  - Mobile communications equipment
  - Broadcast and studio
  - Other telecom
- Industrial
  - Security/energy management
  - Manufacturing systems and instrumentation
  - Medical equipment
  - Other industrial systems
- Consumer
  - Audio
  - Video
  - Personal electronics
  - Appliances
  - Other consumer
- Military/Civilian Aerospace
- Transportation

Data Sources

The historical information presented in the production data has been consolidated from a variety of sources, each of which focuses on a specific part of the market. These sources include the following:

- Dataquest's estimates of systems manufacturers' factory revenue
- U.S. Department of Commerce estimates of manufacturers' shipments
- Japanese production statistics compiled and published by the Ministry of International Trade and Industry
- Various European and Asian nations' governmental agency statistics
- Trade association data
- Estimates presented by knowledgeable and reliable industry spokespersons
- Published product literature and prices

Dataquest believes that the estimates presented here are the most accurate and meaningful generally available today.

Valuation of Production

Regional production is expressed in U.S. dollars. To make the tables in this booklet useful in comparing different regions, it is necessary to express all values in a common currency, and we choose the U.S. dollar for convenience. However, the choice of the U.S. dollar or any other currency brings with it some problems (listed as follows) that require the readers' careful consideration in interpreting the data.

- Inflation—No adjustment has been made in the historical or forecast data to account for the effects of past inflation or expected future inflation. Production is expressed in current dollars (i.e., dollars that include the effects of inflation and changes in exchange rates).
- Exchange rates—Construction of the European tables involves combining data from many countries, each of which has a different and changing exchange rate. Dataquest uses Annual Foreign Exchange Rates for each year as published by the International Monetary Fund. As much as possible, we prepare our estimates in terms of local currencies before conversion to U.S. dollars. Exchange rates during the forecast period are held constant at their 1990 values.

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Table 1a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Each
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Data Processing										
Computers	92,100	103,432	107,895	118,638	130,950	143,105	154,710	166,859	10.0	9.1
Data Storage	19,676	21,162	21,534	23,999	25,620	27,915	29,836	31,942	11.4	8.2
Terminals	14,048	14,183	14,929	17,693	19,677	21,637	23,581	26,284	18.5	12.0
Input/Output	19,943	21,277	23,073	26,084	29,548	32,723	36,119	39,920	13.0	11.6
Dedicated Systems	17,359	17,935	17,552	19,643	21,869	23,793	24,893	27,770	11.9	9.6
Total	163,126	177,989	184,983	206,057	227,664	249,173	269,139	292,775	11.4	9.6
Communications										
Premises Telecom	31,405	35,990	38,755	42,953	47,288	51,031	54,544	59,830	10.8	9.1
Public Telecom	24,616	24,475	27,732	31,089	33,983	37,127	39,317	42,375	12.1	8.8
Mobile Communications	14,450	15,074	16,785	18,620	20,308	22,389	24,237	26,473	10.9	9.5
Broadcast & Studio	3,435	3,682	4,079	4,459	4,800	5,145	5,457	5,878	9.3	7.6
Other Communication	7,825	7,985	8,633	9,356	10,103	10,911	11,533	12,197	8.4	7.2
Total	81,731	87,206	95,984	106,477	116,482	126,603	135,088	146,753	10.9	8.9
Industrial										
Security & Energy Management	6,435	6,849	7,560	8,291	9,046	9,961	10,995	12,178	9.7	10.0
Manufacturing Systems/Instruments	50,918	53,445	56,950	61,307	66,324	71,498	75,578	80,375	7.7	7.1
Medical Equipment	15,128	15,809	16,173	17,498	18,840	20,226	21,488	22,961	8.2	7.3
Other Industrial	11,428	12,159	12,354	13,247	14,307	15,400	16,194	17,183	7.2	6.8
Total	83,909	88,262	93,037	100,343	108,517	117,085	124,255	132,717	7.9	7.4
Consumer										
Audio	16,228	16,110	17,150	18,682	19,921	20,846	21,334	22,747	8.9	5.8
Video	40,725	40,709	43,866	46,529	51,201	53,911	57,713	61,820	6.1	7.1
Personal Electronics	13,473	14,694	17,627	19,233	21,136	22,178	22,656	23,939	9.1	6.3
Appliances	47,238	50,335	52,069	57,753	62,785	66,694	71,378	76,920	10.9	8.1
Other Consumer	5,001	5,151	5,355	5,734	6,255	6,532	6,791	7,288	7.1	6.4
Total	122,665	126,999	136,067	147,931	161,298	170,161	179,872	192,714	8.7	7.2
Military/Aerospace	84,604	87,213	87,620	83,698	88,195	91,923	95,446	99,703	-4.5	2.6
Transportation	13,196	14,352	15,624	16,795	18,916	21,290	24,000	26,481	7.5	11.1
Total Equipment	549,231	582,021	613,315	661,301	721,072	776,235	827,800	891,143	7.8	7.8

Source: Dataquest (May 1991)

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Table 1b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company:	All
Product:	Each
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1989	1990	1991	1992	1993	1994	1995
Data Processing							
Computers	12.3	4.3	10.0	10.4	9.3	8.1	7.9
Data Storage	7.6	1.8	11.4	6.8	9.0	6.9	7.1
Terminals	1.0	5.3	18.5	11.2	10.0	9.0	11.5
Input/Output	6.7	8.4	13.0	13.3	10.7	10.4	10.5
Dedicated Systems	3.3	-2.1	11.9	11.3	8.8	4.6	11.6
Total	9.1	3.9	11.4	10.5	9.4	8.0	8.8
Communications							
Premises Telecom	14.6	7.7	10.8	10.1	7.9	6.9	9.7
Public Telecom	-.6	13.3	12.1	9.3	9.3	5.9	7.8
Mobile Communications	4.3	11.4	10.9	9.1	10.2	8.3	9.2
Broadcast & Studio	7.2	10.8	9.3	7.6	7.2	6.1	7.7
Other Communication	2.0	8.1	8.4	8.0	8.0	5.7	5.8
Total	6.7	10.1	10.9	9.4	8.7	6.7	8.6
Industrial							
Security & Energy Management	6.4	10.4	9.7	9.1	10.1	10.4	10.8
Manufacturing Systems/Instruments	5.0	6.6	7.7	8.2	7.8	5.7	6.3
Medical Equipment	4.5	2.3	8.2	7.7	7.4	6.2	6.9
Other Industrial	6.4	1.6	7.2	8.0	7.6	5.2	6.1
Total	5.2	5.4	7.9	8.1	7.9	6.1	6.8
Consumer							
Audio	-.7	6.5	8.9	6.6	4.6	2.3	6.6
Video	-.0	7.8	6.1	10.0	5.3	7.1	7.1
Personal Electronics	9.1	20.0	9.1	9.9	4.9	2.2	5.7
Appliances	6.6	3.4	10.9	8.7	6.2	7.0	7.8
Other Consumer	3.0	4.0	7.1	9.1	4.4	4.0	7.3
Total	3.5	7.1	8.7	9.0	5.5	5.7	7.1
Military/Aerospace	3.1	.5	-4.5	5.4	4.2	3.8	4.5
Transportation	8.8	8.9	7.5	12.6	12.6	12.7	10.3
Total Equipment	6.0	5.4	7.8	9.0	7.7	6.6	7.7

Source: Dataquest (May 1991)

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Table 1c
Electronic Equipment Production Forecast
(Percent of Total Equipment)

Company: All
Product: Each
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	16.8	17.8	17.6	17.9	18.2	18.4	18.7	18.7
Data Storage	3.6	3.6	3.5	3.6	3.6	3.6	3.6	3.6
Terminals	2.6	2.4	2.4	2.7	2.7	2.8	2.8	2.9
Input/Output	3.6	3.7	3.8	3.9	4.1	4.2	4.4	4.5
Dedicated Systems	3.2	3.1	2.9	3.0	3.0	3.1	3.0	3.1
Total	29.7	30.6	30.2	31.2	31.6	32.1	32.5	32.9
Communications								
Premises Telecom	5.7	6.2	6.3	6.5	6.6	6.6	6.6	6.7
Public Telecom	4.5	4.2	4.5	4.7	4.7	4.8	4.7	4.8
Mobile Communications	2.6	2.6	2.7	2.8	2.8	2.9	2.9	3.0
Broadcast & Studio	.6	.6	.7	.7	.7	.7	.7	.7
Other Communication	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Total	14.9	15.0	15.7	16.1	16.2	16.3	16.3	16.5
Industrial								
Security & Energy Management	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4
Manufacturing Systems/Instruments	9.3	9.2	9.3	9.3	9.2	9.2	9.1	9.0
Medical Equipment	2.8	2.7	2.6	2.6	2.6	2.6	2.6	2.6
Other Industrial	2.1	2.1	2.0	2.0	2.0	2.0	2.0	1.9
Total	15.3	15.2	15.2	15.2	15.0	15.1	15.0	14.9
Consumer								
Audio	3.0	2.8	2.8	2.8	2.8	2.7	2.6	2.6
Video	7.4	7.0	7.2	7.0	7.1	6.9	7.0	6.9
Personal Electronics	2.5	2.5	2.9	2.9	2.9	2.9	2.7	2.7
Appliances	8.6	8.6	8.5	8.7	8.7	8.6	8.6	8.6
Other Consumer	.9	.9	.9	.9	.9	.8	.8	.8
Total	22.3	21.8	22.2	22.4	22.4	21.9	21.7	21.6
Military/Aerospace	15.4	15.0	14.3	12.7	12.2	11.8	11.5	11.2
Transportation	2.4	2.5	2.5	2.5	2.6	2.7	2.9	3.0
Total Equipment	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

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Table 1d
Electronic Equipment Production Forecast
(Percent of Application Market)

Company:	All
Product:	Each
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	56.5	58.1	58.3	57.6	57.5	57.4	57.5	57.0
Data Storage	12.1	11.9	11.6	11.6	11.3	11.2	11.1	10.9
Terminals	8.6	8.0	8.1	8.6	8.6	8.7	8.8	9.0
Input/Output	12.2	12.0	12.5	12.7	13.0	13.1	13.4	13.6
Dedicated Systems	10.6	10.1	9.5	9.5	9.6	9.5	9.2	9.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Communications								
Premises Telecom	38.4	41.3	40.4	40.3	40.6	40.3	40.4	40.8
Public Telecom	30.1	28.1	28.9	29.2	29.2	29.3	29.1	28.9
Mobile Communications	17.7	17.3	17.5	17.5	17.4	17.7	17.9	18.0
Broadcast & Studio	4.2	4.2	4.2	4.2	4.1	4.1	4.0	4.0
Other Communication	9.6	9.2	9.0	8.8	8.7	8.6	8.5	8.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Industrial								
Security & Energy Management	7.7	7.8	8.1	8.3	8.3	8.5	8.8	9.2
Manufacturing Systems/Instruments	60.7	60.6	61.2	61.1	61.1	61.1	60.8	60.6
Medical Equipment	18.0	17.9	17.4	17.4	17.4	17.3	17.3	17.3
Other Industrial	13.6	13.8	13.3	13.2	13.2	13.2	13.0	12.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Consumer								
Audio	13.2	12.7	12.6	12.6	12.4	12.3	11.9	11.8
Video	33.2	32.1	32.2	31.5	31.7	31.7	32.1	32.1
Personal Electronics	11.0	11.6	13.0	13.0	13.1	13.0	12.6	12.4
Appliances	38.5	39.6	38.3	39.0	38.9	39.2	39.7	39.9
Other Consumer	4.1	4.1	3.9	3.9	3.9	3.8	3.8	3.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Military/Aerospace	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Transportation	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

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Table 2a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Each
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
North America										
Data Processing	73,428	78,717	82,851	86,968	93,584	100,146	106,665	113,558	5.0	6.5
Communications	25,409	28,227	30,188	32,520	35,408	37,972	40,184	42,614	7.7	7.1
Industrial	30,385	32,386	33,690	35,233	37,834	40,704	43,254	46,062	4.6	6.5
Consumer	15,454	17,081	17,005	17,396	18,370	19,236	20,145	20,974	2.3	4.3
Military/Aerospace	58,179	59,876	60,569	56,476	59,934	62,275	64,419	67,195	-6.8	2.1
Transportation	4,131	4,151	4,115	4,024	4,535	4,996	5,424	5,721	-2.2	6.8
Total	206,986	220,438	228,418	232,617	249,665	265,329	280,091	296,124	1.8	5.3
Japan										
Data Processing	45,638	47,942	46,625	54,197	59,485	64,817	68,021	72,913	16.2	9.4
Communications	20,008	19,109	20,826	24,070	25,952	27,894	29,186	31,232	15.6	8.4
Industrial	19,885	22,065	22,507	25,459	27,954	30,351	32,076	34,235	13.1	8.8
Consumer	54,716	51,703	54,007	60,202	63,854	64,249	64,824	66,736	11.5	4.3
Military/Aerospace	1,101	1,239	1,356	1,468	1,616	1,785	1,971	2,169	8.3	9.8
Transportation	4,621	5,008	5,596	5,900	6,407	6,768	7,061	7,429	5.4	5.8
Total	145,969	147,066	150,917	171,296	185,268	195,864	203,139	214,714	13.5	7.3
Europe										
Data Processing	21,353	26,375	28,151	32,959	38,167	43,055	48,029	54,182	17.1	14.0
Communications	28,084	30,925	34,515	38,074	41,587	45,366	48,607	53,490	10.3	9.2
Industrial	31,425	31,378	33,920	36,282	38,874	41,717	44,125	47,184	7.0	6.8
Consumer	30,752	34,322	37,282	40,341	43,661	47,327	51,707	57,355	8.2	9.0
Military/Aerospace	22,190	22,817	22,112	21,847	22,327	22,863	23,549	24,350	-1.2	1.9
Transportation	3,052	3,568	4,061	4,747	5,523	6,670	8,219	9,551	16.9	18.7
Total	136,856	149,385	160,041	174,250	190,139	206,998	224,236	246,112	8.9	9.0
Asia/Pacific-ROW										
Data Processing	22,707	24,954	27,356	31,934	36,428	41,155	46,424	52,122	16.7	13.8
Communications	8,230	8,945	10,455	11,813	13,535	15,371	17,111	19,417	13.0	13.2
Industrial	2,214	2,433	2,920	3,369	3,855	4,313	4,800	5,236	15.4	12.4
Consumer	21,743	23,893	27,773	29,992	35,413	39,349	43,196	47,649	8.0	11.4
Military/Aerospace	3,134	3,281	3,583	3,907	4,318	5,000	5,507	5,989	9.0	10.8
Transportation	1,392	1,625	1,852	2,124	2,451	2,856	3,296	3,780	14.7	15.3
Total	59,420	65,131	73,939	83,139	96,000	108,044	120,334	134,193	12.4	12.7
Worldwide										
Data Processing	163,126	177,988	184,983	206,058	227,664	249,173	269,139	292,775	11.4	9.6
Communications	81,731	87,206	95,984	106,477	116,482	126,603	135,088	146,753	10.9	8.9
Industrial	83,909	88,262	93,037	100,343	108,517	117,085	124,255	132,717	7.9	7.4
Consumer	122,665	126,999	136,067	147,931	161,298	170,161	179,872	192,714	8.7	7.2
Military/Aerospace	84,604	87,213	87,620	83,698	88,195	91,923	95,446	99,703	-4.5	2.6
Transportation	13,196	14,352	15,624	16,795	18,916	21,290	24,000	26,481	7.5	11.1
Total	549,231	582,020	613,315	661,302	721,072	776,235	827,800	891,143	7.8	7.8

Source: Dataquest (May 1991)

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Table 2b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Each
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
North America							
Data Processing	7.2	5.3	5.0	7.6	7.0	6.5	6.5
Communications	11.1	6.9	7.7	8.9	7.2	5.8	6.0
Industrial	6.6	4.0	4.6	7.4	7.6	6.3	6.5
Consumer	10.5	-.4	2.3	5.6	4.7	4.7	4.1
Military/Aerospace	2.9	1.2	-6.8	6.1	3.9	3.4	4.3
Transportation	.5	-.9	-2.2	12.7	10.2	8.6	5.5
Total	6.5	3.6	1.8	7.3	6.3	5.6	5.7
Japan							
Data Processing	5.0	-2.7	16.2	9.8	9.0	4.9	7.2
Communications	-4.5	9.0	15.6	7.8	7.5	4.6	7.0
Industrial	11.0	2.0	13.1	9.8	8.6	5.7	6.7
Consumer	-5.5	4.5	11.5	6.1	.6	.9	2.9
Military/Aerospace	12.5	9.4	8.3	10.1	10.5	10.4	10.0
Transportation	8.4	11.7	5.4	8.6	5.6	4.3	5.2
Total	.8	2.6	13.5	8.2	5.7	3.7	5.7
Europe							
Data Processing	23.5	6.7	17.1	15.8	12.8	11.6	12.8
Communications	10.1	11.6	10.3	9.2	9.1	7.1	10.0
Industrial	-.1	8.1	7.0	7.1	7.3	5.8	6.9
Consumer	11.6	8.6	8.2	8.2	8.4	9.3	10.9
Military/Aerospace	2.8	-3.1	-1.2	2.2	2.4	3.0	3.4
Transportation	16.9	13.8	16.9	16.3	20.8	23.2	16.2
Total	9.2	7.1	8.9	9.1	8.9	8.3	9.8
Asia/Pacific-ROW							
Data Processing	9.9	9.6	16.7	14.1	13.0	12.8	12.3
Communications	8.7	16.9	13.0	14.6	13.6	11.3	13.5
Industrial	9.9	20.0	15.4	14.4	11.9	11.3	9.1
Consumer	9.9	16.2	8.0	18.1	11.1	9.8	10.3
Military/Aerospace	4.7	9.2	9.0	10.5	15.8	10.1	8.8
Transportation	16.7	14.0	14.7	15.4	16.5	15.4	14.7
Total	9.6	13.5	12.4	15.5	12.5	11.4	11.5
Worldwide							
Data Processing	9.1	3.9	11.4	10.5	9.4	8.0	8.8
Communications	6.7	10.1	10.9	9.4	8.7	6.7	8.6
Industrial	5.2	5.4	7.9	8.1	7.9	6.1	6.8
Consumer	3.5	7.1	8.7	9.0	5.5	5.7	7.1
Military/Aerospace	3.1	.5	-4.5	5.4	4.2	3.8	4.5
Transportation	8.8	8.9	7.5	12.6	12.6	12.7	10.3
Total	6.0	5.4	7.8	9.0	7.7	6.6	7.7

Source: Dataquest (May 1991)

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Table 2c
Electronic Equipment Production Forecast
(Percent of Regional Total)

Company:	All
Product:	Each
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
North America								
Data Processing	35.5	35.7	36.3	37.4	37.5	37.7	38.1	38.3
Communications	12.3	12.8	13.2	14.0	14.2	14.3	14.3	14.4
Industrial	14.7	14.7	14.7	15.1	15.2	15.3	15.4	15.6
Consumer	7.5	7.7	7.4	7.5	7.4	7.2	7.2	7.1
Military/Aerospace	28.1	27.2	26.5	24.3	24.0	23.5	23.0	22.7
Transportation	2.0	1.9	1.8	1.7	1.8	1.9	1.9	1.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Japan								
Data Processing	31.3	32.6	30.9	31.6	32.1	33.1	33.5	34.0
Communications	13.7	13.0	13.8	14.1	14.0	14.2	14.4	14.5
Industrial	13.6	15.0	14.9	14.9	15.1	15.5	15.8	15.9
Consumer	37.5	35.2	35.8	35.1	34.5	32.8	31.9	31.1
Military/Aerospace	.8	.8	.9	.9	.9	.9	1.0	1.0
Transportation	3.2	3.4	3.7	3.4	3.5	3.5	3.5	3.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Europe								
Data Processing	15.6	17.7	17.6	18.9	20.1	20.8	21.4	22.0
Communications	20.5	20.7	21.6	21.9	21.9	21.9	21.7	21.7
Industrial	23.0	21.0	21.2	20.8	20.4	20.2	19.7	19.2
Consumer	22.5	23.0	23.3	23.2	23.0	22.9	23.1	23.3
Military/Aerospace	16.2	15.3	13.8	12.5	11.7	11.0	10.5	9.9
Transportation	2.2	2.4	2.5	2.7	2.9	3.2	3.7	3.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Asia/Pacific-ROW								
Data Processing	38.2	38.3	37.0	38.4	37.9	38.1	38.6	38.8
Communications	13.9	13.7	14.1	14.2	14.1	14.2	14.2	14.5
Industrial	3.7	3.7	3.9	4.1	4.0	4.0	4.0	3.9
Consumer	36.6	36.7	37.6	36.1	36.9	36.4	35.9	35.5
Military/Aerospace	5.3	5.0	4.8	4.7	4.5	4.6	4.6	4.5
Transportation	2.3	2.5	2.5	2.6	2.6	2.6	2.7	2.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Worldwide								
Data Processing	29.7	30.6	30.2	31.2	31.6	32.1	32.5	32.9
Communications	14.9	15.0	15.7	16.1	16.2	16.3	16.3	16.5
Industrial	15.3	15.2	15.2	15.2	15.0	15.1	15.0	14.9
Consumer	22.3	21.8	22.2	22.4	22.4	21.9	21.7	21.6
Military/Aerospace	15.4	15.0	14.3	12.7	12.2	11.8	11.5	11.2
Transportation	2.4	2.5	2.5	2.5	2.6	2.7	2.9	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

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Table 2d
Electronic Equipment Production Forecast
(Percent of Worldwide Total)

Company: All
Product: Each
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America								
Data Processing	13.4	13.5	13.5	13.2	13.0	12.9	12.9	12.7
Communications	4.6	4.8	4.9	4.9	4.9	4.9	4.9	4.8
Industrial	5.5	5.6	5.5	5.3	5.2	5.2	5.2	5.2
Consumer	2.8	2.9	2.8	2.6	2.5	2.5	2.4	2.4
Military/Aerospace	10.6	10.3	9.9	8.5	8.3	8.0	7.8	7.5
Transportation	.8	.7	.7	.6	.6	.6	.7	.6
Total	37.7	37.9	37.2	35.2	34.6	34.2	33.8	33.2
Japan								
Data Processing	8.3	8.2	7.6	8.2	8.2	8.4	8.2	8.2
Communications	3.6	3.3	3.4	3.6	3.6	3.6	3.5	3.5
Industrial	3.6	3.8	3.7	3.8	3.9	3.9	3.9	3.8
Consumer	10.0	8.9	8.8	9.1	8.9	8.3	7.8	7.5
Military/Aerospace	.2	.2	.2	.2	.2	.2	.2	.2
Transportation	.8	.9	.9	.9	.9	.9	.9	.8
Total	26.6	25.3	24.6	25.9	25.7	25.2	24.5	24.1
Europe								
Data Processing	3.9	4.5	4.6	5.0	5.3	5.5	5.8	6.1
Communications	5.1	5.3	5.6	5.8	5.8	5.8	5.9	6.0
Industrial	5.7	5.4	5.5	5.5	5.4	5.4	5.3	5.3
Consumer	5.6	5.9	6.1	6.1	6.1	6.1	6.2	6.4
Military/Aerospace	4.0	3.9	3.6	3.3	3.1	2.9	2.8	2.7
Transportation	.6	.6	.7	.7	.8	.9	1.0	1.1
Total	24.9	25.7	26.1	26.3	26.4	26.7	27.1	27.6
Asia/Pacific-ROW								
Data Processing	4.1	4.3	4.5	4.8	5.1	5.3	5.6	5.8
Communications	1.5	1.5	1.7	1.8	1.9	2.0	2.1	2.2
Industrial	.4	.4	.5	.5	.5	.6	.6	.6
Consumer	4.0	4.1	4.5	4.5	4.9	5.1	5.2	5.3
Military/Aerospace	.6	.6	.6	.6	.6	.6	.7	.7
Transportation	.3	.3	.3	.3	.3	.4	.4	.4
Total	10.8	11.2	12.1	12.6	13.3	13.9	14.5	15.1
Worldwide								
Data Processing	29.7	30.6	30.2	31.2	31.6	32.1	32.5	32.9
Communications	14.9	15.0	15.7	16.1	16.2	16.3	16.3	16.5
Industrial	15.3	15.2	15.2	15.2	15.0	15.1	15.0	14.9
Consumer	22.3	21.8	22.2	22.4	22.4	21.9	21.7	21.6
Military/Aerospace	15.4	15.0	14.3	12.7	12.2	11.8	11.5	11.2
Transportation	2.4	2.5	2.5	2.5	2.6	2.7	2.9	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

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Table 3a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Each
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Data Processing										
Computers	49,427	52,992	55,750	57,840	61,824	65,373	69,247	72,884	3.7	5.5
Data Storage	6,189	6,677	7,015	7,325	7,235	7,602	8,048	8,750	4.4	4.5
Terminals	2,312	2,179	2,082	2,355	2,741	3,025	3,045	3,117	13.1	8.4
Input/Output	10,393	11,845	13,209	14,684	16,607	18,593	20,433	22,561	11.2	11.3
Dedicated Systems	5,107	5,024	4,795	4,764	5,177	5,553	5,892	6,246	-.6	5.4
Total	73,428	78,717	82,851	86,968	93,584	100,146	106,665	113,558	5.0	6.5
Communications										
Premises Telecom	10,782	12,891	14,350	15,894	17,631	18,955	19,820	20,938	10.8	7.8
Public Telecom	6,740	7,020	7,211	7,595	8,264	8,947	9,705	10,392	5.3	7.6
Mobile Communications	2,305	2,576	2,724	2,908	3,138	3,431	3,788	4,123	6.8	8.6
Broadcast & Studio	1,784	1,905	1,973	2,031	2,114	2,207	2,286	2,385	2.9	3.9
Other Communication	3,798	3,835	3,930	4,092	4,261	4,432	4,585	4,776	4.1	4.0
Total	25,409	28,227	30,188	32,520	35,408	37,972	40,184	42,614	7.7	7.1
Industrial										
Security & Energy Management	3,333	3,490	3,691	3,826	3,987	4,203	4,436	4,666	3.7	4.8
Manufacturing Systems/Instruments	17,686	18,916	19,570	20,535	22,240	24,022	25,557	27,135	4.9	6.8
Medical Equipment	5,982	6,355	6,680	7,019	7,492	8,059	8,629	9,281	5.1	6.8
Other Industrial	3,384	3,625	3,749	3,853	4,115	4,420	4,632	4,980	2.8	5.8
Total	30,385	32,386	33,690	35,233	37,834	40,704	43,254	46,062	4.6	6.5
Consumer										
Audio	703	697	707	722	736	750	764	778	2.1	1.9
Video	2,865	3,407	3,375	3,451	3,627	3,774	3,907	4,030	2.3	3.6
Personal Electronics	405	479	491	505	518	533	550	566	2.9	2.9
Appliances	10,480	11,430	11,359	11,618	12,334	12,974	13,666	14,293	2.3	4.7
Other Consumer	1,001	1,068	1,073	1,100	1,155	1,205	1,258	1,307	2.5	4.0
Total	15,454	17,081	17,005	17,396	18,370	19,236	20,145	20,974	2.3	4.3
Military/Aerospace										
Military	51,063	51,727	51,101	45,801	47,962	48,705	49,098	49,930	-10.4	-.5
Civil Aerospace	7,116	8,149	9,468	10,675	11,972	13,570	15,321	17,265	12.7	12.8
Total	58,179	59,876	60,569	56,476	59,934	62,275	64,419	67,195	-6.8	2.1
Transportation	4,131	4,151	4,115	4,024	4,535	4,996	5,424	5,721	-2.2	6.8
Total Equipment	206,986	220,438	228,418	232,617	249,665	265,329	280,091	296,124	1.8	5.3

Source: Dataquest (May 1991)

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Table 3b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Each
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
Data Processing							
Computers	7.2	5.2	3.7	6.9	5.7	5.9	5.3
Data Storage	7.9	5.1	4.4	-1.2	5.1	5.9	8.7
Terminals	-5.8	-4.5	13.1	16.4	10.4	.7	2.4
Input/Output	14.0	11.5	11.2	13.1	12.0	9.9	10.4
Dedicated Systems	-1.6	-4.6	-.6	8.7	7.3	6.1	6.0
Total	7.2	5.3	5.0	7.6	7.0	6.5	6.5
Communications							
Premises Telecom	19.6	11.3	10.8	10.9	7.5	4.6	5.6
Public Telecom	4.2	2.7	5.3	8.8	8.3	8.5	7.1
Mobile Communications	11.8	5.7	6.8	7.9	9.3	10.4	8.8
Broadcast & Studio	6.8	3.6	2.9	4.1	4.4	3.6	4.3
Other Communication	1.0	2.5	4.1	4.1	4.0	3.5	4.2
Total	11.1	6.9	7.7	8.9	7.2	5.8	6.0
Industrial							
Security & Energy Management	4.7	5.8	3.7	4.2	5.4	5.5	5.2
Manufacturing Systems/Instruments	7.0	3.5	4.9	8.3	8.0	6.4	6.2
Medical Equipment	6.2	5.1	5.1	6.7	7.6	7.1	7.6
Other Industrial	7.1	3.4	2.8	6.8	7.4	4.8	7.5
Total	6.6	4.0	4.6	7.4	7.6	6.3	6.5
Consumer							
Audio	-.9	1.4	2.1	1.9	1.9	1.9	1.8
Video	18.9	-.9	2.3	5.1	4.1	3.5	3.1
Personal Electronics	18.3	2.5	2.9	2.6	2.9	3.2	2.9
Appliances	9.1	-.6	2.3	6.2	5.2	5.3	4.6
Other Consumer	6.7	.5	2.5	5.0	4.3	4.4	3.9
Total	10.5	-.4	2.3	5.6	4.7	4.7	4.1
Military/Aerospace	2.9	1.2	-6.8	6.1	3.9	3.4	4.3
Transportation	.5	-.9	-2.2	12.7	10.2	8.6	5.5
Total Equipment	6.5	3.6	1.8	7.3	6.3	5.6	5.7

Source: Dataquest (May 1991)

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Table 3c
Electronic Equipment Production Forecast
(Percent of Worldwide System Group Total)

Company:	All
Product:	Each
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	53.7	51.2	51.7	48.8	47.2	45.7	44.8	43.7
Data Storage	31.5	31.6	32.6	30.5	28.2	27.2	27.0	27.4
Terminals	16.5	15.4	13.9	13.3	13.9	14.0	12.9	11.9
Input/Output	52.1	55.7	57.2	56.3	56.2	56.8	56.6	56.5
Dedicated Systems	29.4	28.0	27.3	24.3	23.7	23.3	23.7	22.5
Total	45.0	44.2	44.8	42.2	41.1	40.2	39.6	38.8
Communications								
Premises Telecom	34.3	35.8	37.0	37.0	37.3	37.1	36.3	35.0
Public Telecom	27.4	28.7	26.0	24.4	24.3	24.1	24.7	24.5
Mobile Communications	16.0	17.1	16.2	15.6	15.5	15.3	15.6	15.6
Broadcast & Studio	51.9	51.7	48.4	45.5	44.0	42.9	41.9	40.6
Other Communication	48.5	48.0	45.5	43.7	42.2	40.6	39.8	39.2
Total	31.1	32.4	31.5	30.5	30.4	30.0	29.7	29.0
Industrial								
Security & Energy Management	51.8	51.0	48.8	46.1	44.1	42.2	40.3	38.3
Manufacturing Systems/Instruments	34.7	35.4	34.4	33.5	33.5	33.6	33.8	33.8
Medical Equipment	39.5	40.2	41.3	40.1	39.8	39.8	40.2	40.4
Other Industrial	29.6	29.8	30.3	29.1	28.8	28.7	28.6	29.0
Total	36.2	36.7	36.2	35.1	34.9	34.8	34.8	34.7
Consumer								
Audio	4.3	4.3	4.1	3.9	3.7	3.6	3.6	3.4
Video	7.0	8.4	7.7	7.4	7.1	7.0	6.8	6.5
Personal Electronics	3.0	3.3	2.8	2.6	2.5	2.4	2.4	2.4
Appliances	22.2	22.7	21.8	20.1	19.6	19.5	19.1	18.6
Other Consumer	20.0	20.7	20.0	19.2	18.5	18.4	18.5	17.9
Total	12.6	13.4	12.5	11.8	11.4	11.3	11.2	10.9
Military/Aerospace	68.8	68.7	69.1	67.5	68.0	67.7	67.5	67.4
Transportation	31.3	28.9	26.3	24.0	24.0	23.5	22.6	21.6
Total Equipment	37.7	37.9	37.2	35.2	34.6	34.2	33.8	33.2

Source: Dataquest (May 1991)

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Table 3d
Electronic Equipment Production Forecast
(Percent of Total Equipment)

Company:	All
Product:	Each
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	23.9	24.0	24.4	24.9	24.8	24.6	24.7	24.6
Data Storage	3.0	3.0	3.1	3.1	2.9	2.9	2.9	3.0
Terminals	1.1	1.0	.9	1.0	1.1	1.1	1.1	1.1
Input/Output	5.0	5.4	5.8	6.3	6.7	7.0	7.3	7.6
Dedicated Systems	2.5	2.3	2.1	2.0	2.1	2.1	2.1	2.1
Total	35.5	35.7	36.3	37.4	37.5	37.7	38.1	38.3
Communications								
Premises Telecom	5.2	5.8	6.3	6.8	7.1	7.1	7.1	7.1
Public Telecom	3.3	3.2	3.2	3.3	3.3	3.4	3.5	3.5
Mobile Communications	1.1	1.2	1.2	1.3	1.3	1.3	1.4	1.4
Broadcast & Studio	.9	.9	.9	.9	.8	.8	.8	.8
Other Communication	1.8	1.7	1.7	1.8	1.7	1.7	1.6	1.6
Total	12.3	12.8	13.2	14.0	14.2	14.3	14.3	14.4
Industrial								
Security & Energy Management	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Manufacturing Systems/Instruments	8.5	8.6	8.6	8.8	8.9	9.1	9.1	9.2
Medical Equipment	2.9	2.9	2.9	3.0	3.0	3.0	3.1	3.1
Other Industrial	2.9	1.6	1.6	1.7	1.6	1.7	1.7	1.7
Total	14.7	14.7	14.7	15.1	15.2	15.3	15.4	15.6
Consumer								
Audio	.3	.3	.3	.3	.3	.3	.3	.3
Video	1.4	1.5	1.5	1.5	1.5	1.4	1.4	1.4
Personal Electronics	.2	.2	.2	.2	.2	.2	.2	.2
Appliances	5.1	5.2	5.0	5.0	4.9	4.9	4.9	4.8
Other Consumer	.5	.5	.5	.5	.5	.5	.4	.4
Total	7.5	7.7	7.4	7.5	7.4	7.2	7.2	7.1
Military/Aerospace	28.1	27.2	26.5	24.3	24.0	23.5	23.0	22.7
Transportation	2.0	1.9	1.8	1.7	1.8	1.9	1.9	1.9
Total Equipment	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

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Table 3e
Electronic Equipment Production Forecast
(Percent of Application Market)

Company: All
Product: Each
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	67.3	67.3	67.3	66.5	66.1	65.3	64.9	64.2
Data Storage	8.4	8.5	8.5	8.4	7.7	7.6	7.5	7.7
Terminals	3.1	2.8	2.5	2.7	2.9	3.0	2.9	2.7
Input/Output	14.2	15.0	15.9	16.9	17.7	18.6	19.2	19.9
Dedicated Systems	7.0	6.4	5.8	5.5	5.5	5.5	5.5	5.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Communications								
Premises Telecom	42.4	45.7	47.5	48.9	49.8	49.9	49.3	49.1
Public Telecom	26.5	24.9	23.9	23.4	23.3	23.6	24.2	24.4
Mobile Communications	9.1	9.1	9.0	8.9	8.9	9.0	9.4	9.7
Broadcast & Studio	7.0	6.7	6.5	6.2	6.0	5.8	5.7	5.6
Other Communication	14.9	13.6	13.0	12.6	12.0	11.7	11.4	11.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Industrial								
Security & Energy Management	11.0	10.8	11.0	10.9	10.5	10.3	10.3	10.1
Manufacturing Systems/Instruments	58.2	58.4	58.1	58.3	58.8	59.0	59.1	58.9
Medical Equipment	19.7	19.6	19.8	19.9	19.8	19.8	19.9	20.1
Other Industrial	11.1	11.2	11.1	10.9	10.9	10.9	10.7	10.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Consumer								
Audio	4.5	4.1	4.2	4.2	4.0	3.9	3.8	3.7
Video	18.5	19.9	19.8	19.8	19.7	19.6	19.4	19.2
Personal Electronics	2.6	2.8	2.9	2.9	2.8	2.8	2.7	2.7
Appliances	67.8	66.9	66.8	66.8	67.1	67.4	67.8	68.1
Other Consumer	6.5	6.3	6.3	6.3	6.3	6.3	6.2	6.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Military/Aerospace	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Transportation	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

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Table 4a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Data Processing
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Computers										
Supercomputers	934	945	1,081	1,194	1,385	1,517	1,711	1,908	10.4	12.0
Mainframe	17,743	18,517	19,065	18,677	18,954	18,646	18,400	18,031	-2.0	-1.1
Midrange	15,993	17,201	18,417	18,831	19,384	20,000	20,677	21,354	2.2	3.0
Workstation	3,196	4,335	5,037	6,086	7,789	9,541	11,400	13,028	20.8	20.9
Personal Computer	11,561	11,993	12,150	13,052	14,312	15,669	17,059	18,564	7.4	8.8
Total	49,427	52,992	55,750	57,840	61,824	65,373	69,247	72,884	3.7	5.5
Rigid Disk Drives										
14 inch	2,141	1,919	1,715	1,511	1,193	1,037	853	747	-11.9	-15.3
8-10 inch	694	612	446	323	233	161	128	98	-27.6	-26.2
5.25 inch	1,680	1,835	1,635	1,496	1,356	1,362	1,186	1,013	-8.5	-9.1
3.5 inch	931	1,438	2,236	2,824	3,245	3,751	4,362	5,126	26.3	18.1
2.5 inch	0	4	64	249	287	356	496	664	287.7	59.6
Total	5,446	5,808	6,096	6,403	6,314	6,667	7,024	7,648	5.0	4.6
Optical Drives										
Rewrite Optical Disk Drives	3	16	25	46	77	114	161	217	83.3	53.7
WORM Optical Drives	17	20	23	27	30	35	40	46	16.2	14.9
CD-ROM	1	1	1	1	2	3	5	7	3.9	39.8
Total	21	37	50	74	109	152	206	270	50.0	40.3
Tape Drives	665	784	824	802	765	736	769	781	-2.7	-1.1
Flexible Drives										
3.5-inch Flexible Drives	20	22	27	34	37	41	45	49	26.7	12.9
5.25-inch Flexible Drives	21	19	16	12	8	6	4	3	-24.3	-28.7
8-inch Flexible Drives	17	7	3	1	0	0	0	0	-69.7	-50.2
Total	58	48	45	46	46	47	49	52	3.4	3.0
Data Storage/Subsystems—Total	6,189	6,677	7,015	7,325	7,235	7,602	8,048	8,750	4.4	4.5
Graphics Terminals										
X-Terminals	0	0	139	412	708	904	940	1,034	196.0	49.3
Other Graphics Terminals	681	557	452	307	300	277	194	133	-32.1	-21.7
Total	681	557	591	720	1,008	1,181	1,134	1,167	21.7	14.6
Alphanumeric Terminals	1,631	1,622	1,490	1,636	1,732	1,844	1,911	1,950	9.8	5.5
Terminals—Total	2,312	2,179	2,082	2,355	2,741	3,025	3,045	3,117	13.1	8.4
Printers										
Serial Printers	2,033	1,802	1,596	1,498	1,397	1,358	1,292	1,267	-6.2	-4.5
Line Printers	994	989	912	943	1,007	1,051	1,026	1,024	3.4	2.3
Page Printers	4,049	5,516	6,984	8,062	9,145	10,114	10,890	11,746	15.4	11.0
Total	7,075	8,306	9,493	10,503	11,548	12,522	13,209	14,036	10.6	8.1
Other Input/Output	3,317	3,540	3,717	4,181	5,059	6,071	7,225	8,525	12.5	18.1
Input/Output—Total	10,393	11,845	13,209	14,684	16,607	18,593	20,433	22,561	11.2	11.3

(Continued)

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Table 4a (Continued)
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Data Processing
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Copiers and Duplicators										
Personal Copiers	69	73	79	88	98	108	116	125	10.5	9.6
Segments 1-3	929	903	863	923	1,017	1,099	1,170	1,246	6.9	7.6
Segment 4-6	491	509	482	569	656	732	772	813	18.1	11.0
Total	1,489	1,484	1,425	1,580	1,771	1,939	2,058	2,185	10.9	8.9
Other Dedicated Systems	3,618	3,540	3,370	3,183	3,406	3,614	3,834	4,060	-5.6	3.8
Dedicated Systems—Total	5,107	5,024	4,795	4,764	5,177	5,553	5,892	6,246	-.7	5.4
Data Processing—Total	73,429	78,717	82,851	86,969	93,583	100,146	106,667	113,558	5.0	6.5

Source: Dataquest (May 1991)

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Table 4b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Data Processing
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
Computers							
Supercomputers	1.2	14.4	10.4	16.0	9.6	12.8	11.5
Mainframe	4.4	3.0	-2.0	1.5	-1.6	-1.3	-2.0
Midrange	7.6	7.1	2.2	2.9	3.2	3.4	3.3
Workstation	35.7	16.2	20.8	28.0	22.5	19.5	14.3
Personal Computer	3.7	1.3	7.4	9.7	9.5	8.9	8.8
Total	7.2	5.2	3.7	6.9	5.7	5.9	5.3
Rigid Disk Drives							
14 inch	-10.4	-10.6	-11.9	-21.0	-13.1	-17.8	-12.4
8-10 inch	-11.8	-27.1	-27.6	-27.9	-30.7	-20.9	-23.3
5.25 inch	9.2	-10.9	-8.5	-9.3	.4	-13.0	-14.5
3.5 inch	54.6	55.4	26.3	14.9	15.6	16.3	17.5
2.5 inch	—	1627.3	287.7	15.5	24.0	39.4	33.8
Total	6.7	5.0	5.0	-1.4	5.6	5.4	8.9
Optical Drives							
Rewrite Optical Disk Drives	524.6	61.3	83.3	66.7	48.1	41.0	34.4
WORM Optical Drives	15.0	15.2	16.2	13.1	15.3	15.3	14.5
CD-ROM	58.7	6.4	3.9	37.9	60.1	58.0	47.4
Total	78.4	34.5	50.0	46.8	39.2	35.4	30.8
Flexible Drives							
Tape Drives	17.8	5.1	-2.7	-4.6	-3.8	4.5	1.6
3.5-inch Flexible Drives	11.7	20.3	26.7	10.6	9.9	9.6	8.8
5.25-inch Flexible Drives	-10.5	-18.4	-24.3	-29.5	-30.7	-28.4	-30.3
8-inch Flexible Drives	-55.6	-65.3	-69.7	-39.4	-83.3	.0	-.4
Total	-16.0	-8.0	3.4	-.5	1.6	4.9	5.5
Data Storage/Subsystems—Total	7.9	5.1	4.4	-1.2	5.1	5.9	8.7
Graphics Terminals							
X-Terminals	—	—	196.0	71.6	27.7	4.0	10.0
Other Graphics Terminals	-18.3	-18.8	-32.1	-2.3	-7.7	-29.9	-31.5
Total	-18.3	6.2	21.7	40.1	17.2	-4.0	2.9
Alphanumeric Terminals	-.6	-8.1	9.8	5.9	6.4	3.6	2.0
Terminals—Total	-5.8	-4.5	13.1	16.4	10.4	.7	2.3
Printers							
Serial Printers	-11.4	-11.4	-6.2	-6.7	-2.8	-4.8	-2.0
Line Printers	-.5	-7.7	3.4	6.7	4.4	-2.4	-.2
Page Printers	36.2	26.6	15.4	13.4	10.6	7.7	7.9
Total	17.4	14.3	10.6	9.9	8.4	5.5	6.3
Other Input/Output	6.7	5.0	12.5	21.0	20.0	19.0	18.0
Input/Output—Total	14.0	11.5	11.2	13.1	12.0	9.9	10.4

(Continued)

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Table 4b (Continued)
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Data Processing
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
Copiers and Duplicators							
Personal Copiers	5.0	9.2	10.5	11.7	10.2	7.8	7.8
Segments 1-3	-2.9	-4.3	6.9	10.2	8.0	6.5	6.5
Segment 4-6	3.6	-5.2	18.1	15.1	11.6	5.4	5.4
Total	-.3	-4.0	10.9	12.0	9.5	6.2	6.2
Other Dedicated Systems	-2.2	-4.8	-5.6	7.0	6.1	6.1	5.9
Dedicated Systems—Total	-1.6	-4.6	-.7	8.7	7.3	6.1	6.0
Data Processing—Total	7.2	5.3	5.0	7.6	7.0	6.5	6.5

Source: Dataquest (May 1991)

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Table 4c
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Communications
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Image & Text Communication Equipment										
Facsimile	160	134	137	149	163	176	192	207	8.6	8.6
Video Teleconferencing	30	60	76	102	134	172	217	273	34.4	29.2
Total	190	193	213	251	296	348	409	480	17.7	17.6
Data Communication Equipment										
Modems	1,262	1,111	1,064	958	805	645	501	411	-10.0	-17.3
Statistical Multiplexers	193	177	163	148	131	114	96	85	-9.7	-12.3
T-1 Multiplexers	388	446	492	536	603	682	731	805	8.9	10.3
Front-End Processors	488	482	479	467	447	422	397	385	-2.5	-4.3
DSU/CSU	125	140	149	150	151	153	154	155	.7	.8
Protocol Converters	164	164	153	143	140	135	130	125	-6.5	-4.0
Local Area Networks	2,580	3,774	4,785	5,885	7,145	7,988	8,348	8,798	23.0	13.0
Network Management	247	837	950	1,064	1,233	1,409	1,565	1,721	12.0	12.6
Packet Data Switching	266	291	306	320	321	310	294	291	4.6	-1.0
Total	5,713	7,422	8,542	9,670	10,976	11,858	12,216	12,776	13.2	8.4
Premise Switching Equipment										
PBX Telephone Systems	2,339	2,178	2,060	2,094	2,144	2,177	2,248	2,293	1.7	2.2
Key Telephone Systems	810	808	780	754	731	710	690	671	-3.3	-3.0
Total	3,149	2,986	2,840	2,848	2,875	2,887	2,938	2,964	.3	.9
Call Processing Equipment										
Voice Messaging	506	647	861	973	1,091	1,202	1,318	1,441	13.0	10.8
Interactive Voice Response System	0	205	404	620	808	1,001	1,206	1,451	53.5	29.1
Call Accounting	256	260	269	285	296	309	322	336	5.9	4.6
Automatic Call Distributors	388	577	645	697	789	890	990	1,098	8.1	11.2
Total	1,150	1,689	2,179	2,575	2,984	3,402	3,836	4,326	18.2	14.7
Desktop Terminal Equipment										
Telephone Sets/Pay Telephones	359	395	387	378	370	361	353	345	-2.3	-2.3
Teleprinters	220	205	190	172	130	98	68	47	-9.5	-24.4
Total	579	600	577	550	500	459	421	392	-4.7	-7.4
Premise Telecom Equipment—Total	10,782	12,891	14,350	15,894	17,631	18,955	19,820	20,938	10.8	7.8
Transmission Equipment										
Multiplex	1,377	1,435	1,465	1,491	1,558	1,622	1,796	1,886	1.8	5.2
Carrier Systems	1,688	1,840	2,010	2,200	2,415	2,664	2,957	3,253	9.5	10.1
Microwave Radio	487	510	547	599	667	736	807	884	9.5	10.1
Other (laser, infrared)	108	119	124	129	135	142	148	156	4.0	4.7
Satellite Communications Equipment	651	693	752	801	993	1,150	1,265	1,373	6.5	12.8
Total	4,311	4,597	4,898	5,220	5,768	6,314	6,973	7,551	6.6	9.0

(Continued)

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Table 4c (Continued)
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Communications
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Central Office Switching Equipment	2,429	2,423	2,313	2,375	2,496	2,633	2,732	2,841	2.7	4.2
Public Telecommunications—Total	6,740	7,020	7,211	7,595	8,264	8,947	9,705	10,392	5.3	7.6
Portable Radio Receiver, Transportation										
Cellular Telephones	201	211	236	245	313	385	499	595	3.8	20.3
Mobile Radio Systems	714	800	860	925	998	1,083	1,165	1,246	7.5	7.7
Mobile Radio Base Station Equipment	473	525	542	601	635	711	812	902	10.9	10.7
Mobile Radio System Equipment	1,388	1,536	1,638	1,770	1,946	2,179	2,476	2,743	8.1	10.9
Total	603	725	769	816	868	924	981	1,046	6.2	6.4
Radio Checkout Equipment	313	315	318	321	325	328	331	334	1.0	1.0
Mobile Communications Equipment—Total	2,305	2,576	2,724	2,908	3,138	3,431	3,788	4,123	6.7	8.6
Broadcast & Radio										
Audio Equipment	314	335	348	362	379	395	410	429	4.2	4.3
Video Equipment	574	605	629	635	665	699	730	766	.9	4.0
Transmitters, RF Power Amps	125	125	125	125	125	125	125	125	.0	.0
Studio Transmitter Links	11	10	10	10	10	10	10	10	.0	.0
Cable TV Equipment	420	450	468	489	513	537	560	587	4.3	4.6
CCTV	99	105	107	111	109	114	110	111	3.7	.7
Other (Studio, Theater)	241	275	286	299	313	328	341	357	4.5	4.5
Total	1,784	1,905	1,973	2,031	2,114	2,207	2,286	2,385	2.9	3.9
Other Telecom										
Intercomm. Equip., Elec. Ampl.	273	275	259	275	280	284	287	293	5.9	2.5
Communications Equipment., Misc.	3,525	3,560	3,670	3,817	3,981	4,149	4,298	4,483	4.0	4.1
Total	3,798	3,835	3,930	4,092	4,261	4,432	4,585	4,776	4.1	4.0
Communications—Total	25,409	28,226	30,188	32,519	35,409	37,972	40,184	42,614	7.7	7.1

Source: Dataquest (May 1991)

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Table 4d
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Communications
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
Image & Text Communication Equipment							
Facsimile	-16.4	2.6	8.6	9.0	8.3	9.3	7.6
Video Teleconferencing	96.4	27.6	34.4	31.3	28.6	25.8	26.0
Total	1.5	10.3	17.7	18.1	17.5	17.5	17.3
Data Communication Equipment							
Modems	-12.0	-4.2	-10.0	-16.0	-19.8	-22.4	-17.9
Statistical Multiplexers	-8.4	-7.6	-9.7	-11.1	-13.1	-15.5	-11.9
T-1 Multiplexers	14.9	10.3	8.9	12.5	13.1	7.2	10.1
Front-End Processors	-1.1	-.8	-2.5	-4.2	-5.7	-5.9	-2.9
DSU/CSU	12.0	6.4	.7	.7	1.3	.7	.6
Protocol Converters	.0	-6.7	-6.5	-2.1	-3.6	-3.7	-3.8
Local Area Networks	46.3	26.8	23.0	21.4	11.8	4.5	5.4
Network Management	238.8	13.6	12.0	15.9	14.3	11.1	10.0
Packet Data Switching	9.5	5.2	4.6	.1	-3.2	-5.3	-1.1
Total	29.9	15.1	13.2	13.5	8.0	3.0	4.6
Premise Switching Equipment							
PBX Telephone Systems	-6.9	-5.4	1.7	2.4	1.6	3.2	2.0
Key Telephone Systems	-.2	-3.5	-3.3	-3.1	-2.9	-2.8	-2.8
Total	-5.2	-4.9	.3	.9	.4	1.7	.9
Call Processing Equipment							
Voice Messaging	27.9	33.1	13.0	12.1	10.2	9.7	9.3
Interactive Voice Response System	—	97.1	53.5	30.3	23.9	20.5	20.3
Call Accounting	1.6	3.5	5.9	3.9	4.4	4.3	4.3
Automatic Call Distributors	48.7	11.6	8.1	13.2	12.8	11.2	10.9
Total	46.9	29.0	18.2	15.9	14.0	12.8	12.8
Desktop Terminal Equipment							
Telephone Sets/Pay Telephones	10.0	-2.0	-2.3	-2.1	-2.4	-2.2	-2.3
Teleprinters	-6.8	-7.3	-9.5	-24.4	-24.6	-30.6	-30.9
Total	3.6	-3.8	-4.7	-9.1	-8.2	-8.3	-6.9
Premise Telecom Equipment—Total	19.6	11.3	10.8	10.9	7.5	4.6	5.6

(Continued)

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Table 4d (Continued)
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company:	All
Product:	Communications
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1989	1990	1991	1992	1993	1994	1995
Transmission Equipment							
Multiplex	4.2	2.1	1.8	4.5	4.1	10.7	5.0
Carrier Systems	9.0	9.2	9.5	9.8	10.3	11.0	10.0
Microwave Radio	4.7	7.3	9.5	11.4	10.3	9.6	9.6
Other (laser, infrared)	10.0	4.4	4.0	5.0	4.8	4.6	4.9
Satellite Communications Equipment	6.5	8.5	6.5	24.0	15.8	10.0	8.5
Total	6.6	6.6	6.6	10.5	9.5	10.4	8.3
Central Office Switching Equipment	-.2	-4.5	2.7	5.1	5.5	3.8	4.0
Public Telecommunications—Total	4.2	2.7	5.3	8.8	8.3	8.5	7.1
Mobile Radio System Equipment							
Cellular Telephones	5.0	11.8	3.8	27.8	23.1	29.5	19.2
Mobile Radio Systems	12.1	7.5	7.5	8.0	8.5	7.5	7.0
Mobile Radio Base Station Equipment	11.1	3.2	10.9	5.6	12.0	14.3	11.0
Total	10.7	6.6	8.1	9.9	12.0	13.6	10.8
Portable Radio Receiver, Transportation	20.2	6.0	6.2	6.3	6.5	6.2	6.6
Radio Checkout Equipment	.3	1.0	1.0	1.0	1.0	1.0	1.0
Mobile Communications Equipment—Total	11.8	5.8	6.7	7.9	9.3	10.4	8.8
Broadcast & Studio							
Audio Equipment	6.7	3.8	4.2	4.6	4.1	3.8	4.8
Video Equipment	5.4	4.0	.9	4.8	5.0	4.5	4.9
Transmitters, RF Power Amps	.0	.0	.0	.0	.0	.0	.0
Studio Transmitter Links	-9.1	.0	.0	.0	.0	.0	.0
Cable TV Equipment	7.2	4.1	4.3	4.9	4.8	4.3	4.8
CCTV	5.6	1.9	3.7	-1.8	4.6	-3.5	.9
Other (Studio, Theater)	14.2	3.9	4.5	4.9	4.6	4.1	4.6
Total	6.8	3.6	2.9	4.1	4.4	3.6	4.3
Other Telecom							
Intercomm. Equip., Elec. Ampl.	.7	-5.7	5.9	1.8	1.5	1.2	2.0
Communications Equipment., Misc.	1.0	3.1	4.0	4.3	4.2	3.6	4.3
Total	1.0	2.5	4.1	4.1	4.0	3.4	4.2
Communications—Total	11.1	7.0	7.7	8.9	7.2	5.8	6.0

Source: Dataquest (May 1991)

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Table 4e
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Industrial
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Alarm Systems										
Intrusion Detection	752	804	875	923	974	1,050	1,129	1,197	5.5	6.5
Fire Detection	413	477	532	570	602	633	666	701	7.2	5.7
Total	1,165	1,281	1,407	1,493	1,575	1,682	1,795	1,898	6.1	6.2
Energy Management Systems	2,168	2,209	2,284	2,332	2,412	2,520	2,641	2,768	2.1	3.9
Security/Energy Management—Total	3,333	3,490	3,691	3,826	3,987	4,203	4,436	4,666	3.6	4.8
Manufacturing Systems										
Semiconductor Production	1,541	1,696	1,691	1,835	2,239	2,700	2,936	3,053	8.5	12.5
Controls and Actuators	3,655	3,895	3,985	4,164	4,476	4,807	5,134	5,494	4.5	6.6
Sensor Systems	1,511	1,640	1,765	1,874	2,030	2,206	2,385	2,595	6.2	8.0
Management Systems	3,405	3,569	3,683	3,790	3,907	4,024	4,137	4,240	2.9	2.9
Robotics	229	256	274	296	326	360	360	398	8.0	7.8
Total	10,340	11,056	11,397	11,958	12,977	14,098	14,952	15,780	4.9	6.7
Instrumentation										
ATE-Semi	583	635	616	639	786	919	1,032	1,167	3.8	13.6
ATE-other	1,379	1,517	1,547	1,602	1,754	1,878	2,019	2,160	3.5	6.9
Oscilloscopes & Waveform Analyzers	714	785	836	881	933	991	1,053	1,117	5.4	6.0
Nuclear Instruments	614	625	636	651	676	706	748	794	2.4	4.6
Electrical Test Instruments	980	1,003	1,029	1,060	1,093	1,131	1,173	1,214	3.0	3.4
Other Test & Measurement	3,075	3,295	3,509	3,744	4,021	4,299	4,578	4,903	6.7	6.9
Total	7,346	7,860	8,173	8,577	9,263	9,924	10,604	11,355	4.9	6.8
Diagnostics										
X-Ray	1,658	1,725	1,756	1,784	1,818	1,862	1,901	1,939	1.6	2.0
Ultrasonic & Scanning	311	320	329	339	353	370	387	407	3.1	4.3
Blood & Body Fluid Analyzers	595	605	618	633	655	681	705	732	2.4	3.4
Other Diagnostics	1,048	1,160	1,278	1,411	1,589	1,808	2,049	2,340	10.4	12.9
Total	3,611	3,810	3,981	4,167	4,416	4,721	5,042	5,417	4.7	6.4
Therapeutic										
Patient Monitoring Equipment	296	305	313	321	330	338	345	353	2.4	2.4
Other Therapeutic	2,075	2,240	2,386	2,531	2,746	2,999	3,242	3,511	6.1	8.0
Total	2,371	2,545	2,699	2,852	3,076	3,337	3,587	3,864	5.7	7.4
Medical Equipment—Total	5,982	6,355	6,680	7,019	7,492	8,059	8,629	9,281	5.1	6.8
Other Industrial Systems—Total	3,384	3,625	3,749	3,853	4,115	4,420	4,632	4,980	2.8	5.8
Industrial—Total	30,385	32,386	33,690	35,234	37,834	40,703	43,254	46,062	4.6	6.5

Source: Dataquest (May 1991)

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Table 4f
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Industrial
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
Alarm Systems							
Intrusion Detection	6.9	8.8	5.5	5.5	7.8	7.6	6.0
Fire Detection	15.4	11.7	7.2	5.5	5.2	5.2	5.3
Total	9.9	9.9	6.1	5.5	6.8	6.7	5.7
Energy Management Systems	1.9	3.4	2.1	3.4	4.5	4.8	4.8
Security/Energy Management—Total	4.7	5.8	3.6	4.2	5.4	5.6	5.2
Manufacturing Systems							
Semiconductor Production	10.1	-.3	8.5	22.0	20.6	8.7	4.0
Controls and Actuators	6.6	2.3	4.5	7.5	7.4	6.8	7.0
Sensor Systems	8.6	7.6	6.2	8.3	8.7	8.1	8.8
Management Systems	4.8	3.2	2.9	3.1	3.0	2.8	2.5
Robotics	12.0	7.0	8.0	10.0	10.7	.0	10.5
Total	6.9	3.1	4.9	8.5	8.6	6.1	5.5
Instrumentation							
ATE-Semi	8.9	-3.0	3.8	23.0	16.8	12.4	13.0
ATE-other	10.0	2.0	3.5	9.5	7.1	7.5	7.0
Oscilloscopes & Waveform Analyze	9.9	6.5	5.4	5.9	6.2	6.3	6.0
Nuclear Instruments	1.8	1.7	2.4	3.8	4.5	5.9	6.2
Electrical Test Instruments	2.4	2.6	3.0	3.1	3.5	3.7	3.5
Other Test & Measurement	7.1	6.5	6.7	7.4	6.9	6.5	7.1
Total	7.0	4.0	4.9	8.0	7.1	6.9	7.1
Diagnostics							
X-Ray	4.1	1.8	1.6	1.9	2.4	2.1	2.0
Ultrasonic & Scanning	3.0	2.8	3.1	4.2	4.8	4.5	5.1
Blood & Body Fluid Analyzers	1.7	2.1	2.4	3.6	3.9	3.6	3.7
Other Diagnostics	10.7	10.2	10.4	12.6	13.8	13.3	14.2
Total	5.5	4.5	4.7	6.0	6.9	6.8	7.4
Therapeutic							
Patient Monitoring Equipment	3.0	2.7	2.4	2.8	2.6	2.1	2.3
Other Therapeutic	8.0	6.5	6.1	8.5	9.2	8.1	8.3
Total	7.3	6.0	5.7	7.9	8.5	7.5	7.7
Medical Equipment—Total	6.2	5.1	5.1	6.7	7.6	7.1	7.6
Other Industrial Systems—Total	7.1	3.4	2.8	6.8	7.4	4.8	7.5
Industrial—Total	6.6	4.0	4.6	7.4	7.6	6.3	6.5

Source: Dataquest (May 1991)

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Table 4g
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Consumer
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	Rate (%)	CAGR (%)
Audio										
Compact Disc Players	3	8	9	9	9	9	9	9	2.4	1.8
Radio	251	228	233	242	246	251	256	261	3.5	2.3
Stereo (Hi-Fi) Components	206	208	207	209	213	217	222	226	1.0	1.8
Musical Instruments	225	235	240	245	250	255	260	265	2.1	2.0
Tape Recorders	18	19	18	18	17	17	17	17	-1.7	-1.4
Total	703	697	707	722	736	750	764	778	2.1	2.0
Video										
VTRs (VCRs)	265	245	265	276	294	314	329	345	3.9	5.4
Video Disk Players	9	1	1	1	1	1	1	1	2.8	3.0
Color Televisions	2,591	3,160	3,110	3,175	3,332	3,460	3,577	3,685	2.1	3.5
Total	2,865	3,406	3,376	3,451	3,628	3,775	3,907	4,031	2.2	3.6
Personal Electronics										
Games	227	301	316	332	348	366	384	403	5.0	5.0
Cameras	23	25	25	25	23	23	23	23	.0	-2.0
Watches	100	100	100	100	100	100	100	100	.0	.0
Clocks	55	53	50	48	46	44	42	40	-4.0	-4.4
Total	405	479	491	505	518	533	550	566	2.8	2.9
Appliances										
Air Conditioners	1,728	1,846	1,935	1,990	2,041	2,094	2,149	2,205	2.8	2.6
Microwave Ovens	716	619	531	507	580	625	644	663	-4.6	4.5
Washers & Dryers	2,888	2,981	3,032	3,141	3,329	3,475	3,629	3,801	3.6	4.6
Refrigerators	3,330	4,024	3,923	4,019	4,267	4,513	4,821	5,083	2.4	5.3
Dishwashers	881	979	981	1,000	1,049	1,108	1,171	1,236	1.9	4.7
Ranges & Ovens	938	982	956	961	1,067	1,158	1,252	1,305	.6	6.4
Total	10,480	11,430	11,359	11,618	12,334	12,974	13,666	14,293	2.3	4.7
Other Consumer										
Automatic Garage Door Openers	265	255	263	272	280	289	298	308	3.2	3.2
Consumer Equipment, Misc.	736	813	810	828	875	916	959	999	2.3	4.3
Total	1,000	1,068	1,073	1,100	1,155	1,205	1,258	1,307	2.5	4.0
Consumer—Total	15,454	17,080	17,005	17,396	18,369	19,236	20,144	20,975	2.3	4.3

Source: Dataquest (May 1991)

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Table 4h
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Consumer
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
Audio							
Compact Disc Players	148.5	3.7	2.4	1.1	2.3	1.1	2.2
Radio	-9.1	2.3	3.5	2.0	1.9	2.0	2.0
Stereo (Hi-Fi) Components	.7	-.2	1.0	2.0	2.0	2.0	2.0
Musical Instruments	4.4	2.1	2.1	2.0	2.0	2.0	1.9
Tape Recorders	3.9	-3.8	-1.7	-1.1	-1.2	-1.8	-1.2
Total	-.8	1.3	2.1	1.9	1.9	1.9	1.9
Video							
VTRs (VCRs)	-7.5	8.2	3.9	6.8	6.7	4.7	4.8
Video Disk Players	-90.2	11.4	2.8	2.7	4.6	2.6	2.5
Color Televisions	22.0	-1.6	2.1	5.0	3.8	3.4	3.0
Total	18.9	-.9	2.2	5.1	4.1	3.5	3.2
Personal Electronics							
Games	32.7	5.0	5.0	5.0	5.0	5.0	5.0
Cameras	8.7	1.2	.0	-7.7	.0	.0	-2.0
Watches	.0	.0	.0	.0	.0	.0	.0
Clocks	-3.6	-5.7	-4.0	-4.2	-4.3	-4.5	-4.8
Total	18.3	2.6	2.8	2.5	3.0	3.1	3.0
Appliances							
Air Conditioners	6.8	4.8	2.8	2.6	2.6	2.6	2.6
Microwave Ovens	-13.5	-14.2	-4.6	14.3	7.8	3.1	3.0
Washers & Dryers	3.2	1.7	3.6	6.0	4.4	4.4	4.7
Refrigerators	20.8	-2.5	2.4	6.2	5.8	6.8	5.5
Dishwashers	11.1	.3	1.9	4.8	5.7	5.7	5.6
Ranges & Ovens	4.7	-2.7	.6	11.1	8.5	8.2	4.2
Total	9.1	-.6	2.3	6.2	5.2	5.3	4.6
Other Consumer							
Automatic Garage Door Openers	-3.7	3.2	3.2	3.2	3.2	3.2	3.2
Consumer Equipment., Misc.	10.5	-.4	2.3	5.6	4.7	4.7	4.1
Total	6.8	.4	2.5	5.0	4.3	4.4	3.9
Consumer—Total	10.5	-.4	2.3	5.6	4.7	4.7	4.1

Source: Dataquest (May 1991)

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Table 41
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Military/Aerospace
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Military										
Radar/Sonar	9,505	9,326	9,000	7,290	8,347	8,055	7,773	7,773	-19.0	-2.9
Missile-Weapon	6,385	6,461	6,280	6,060	5,606	5,886	5,945	5,767	-3.5	-1.7
Space	5,148	5,552	5,608	5,664	6,145	6,667	7,001	7,351	1.0	5.6
Communication/Navigation	6,397	6,546	6,317	5,180	5,076	5,025	5,051	5,152	-18.0	-4.0
Electronic Warfare	5,539	5,571	5,627	4,867	5,183	5,360	5,508	5,729	-13.5	.4
Aircraft Systems	4,327	4,312	4,204	3,321	3,604	3,568	3,532	3,709	-21.0	-2.5
Computer Systems	2,207	2,308	2,421	2,506	2,666	2,840	3,010	3,190	3.5	5.7
Simulation	744	845	946	1,017	1,093	1,164	1,240	1,321	7.5	6.9
Misc. Equip.	10,811	10,806	10,698	9,896	10,242	10,140	10,038	9,938	-7.5	-1.5
Total	51,063	51,727	51,101	45,801	47,962	48,705	49,098	49,930	-10.4	-.5
Civilian										
Radar	1,825	2,080	2,288	2,517	2,857	3,214	3,471	3,679	10.0	10.0
Space	2,470	2,818	3,114	3,347	3,716	4,403	5,284	6,340	7.5	15.3
Communication/Navigation	713	808	990	1,168	1,289	1,412	1,547	1,694	18.0	11.3
Flight Systems	1,892	2,198	2,791	3,308	3,712	4,071	4,464	4,896	18.5	11.9
Simulation	216	245	285	335	398	470	555	656	17.5	18.1
Total	7,116	8,149	9,468	10,675	11,972	13,570	15,321	17,265	12.7	12.8
Military/Aerospace—Total	58,179	59,876	60,569	56,476	59,934	62,275	64,419	67,195	-6.8	2.1

Source: Dataquest (May 1991)

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Table 4j
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company:	All
Product:	Military/Aerospace
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1989	1990	1991	1992	1993	1994	1995
Military							
Radar/Sonar	-1.9	-3.5	-19.0	14.5	-3.5	-3.5	.0
Missile-Weapon	1.2	-2.8	-3.5	-7.5	5.0	1.0	-3.0
Space	7.8	1.0	1.0	8.5	8.5	5.0	5.0
Communication/Navigation	2.3	-3.5	-18.0	-2.0	-1.0	.5	2.0
Electronic Warfare	.6	1.0	-13.5	6.5	3.4	2.8	4.0
Aircraft Systems	-.3	-2.5	-21.0	8.5	-1.0	-1.0	5.0
Computer Systems	4.6	4.9	3.5	6.4	6.5	6.0	6.0
Simulation	13.6	12.0	7.5	7.5	6.5	6.5	6.5
Misc. Equip.	-.0	-1.0	-7.5	3.5	-1.0	-1.0	-1.0
Total	1.3	-1.2	-10.4	4.7	1.5	.8	1.7
Civilian							
Radar	14.0	10.0	10.0	13.5	12.5	8.0	6.0
Space	14.1	10.5	7.5	11.0	18.5	20.0	20.0
Communication/Navigation	13.3	22.5	18.0	10.4	9.5	9.6	9.5
Flight Systems	16.2	27.0	18.5	12.2	9.7	9.7	9.7
Simulation	13.4	16.3	17.5	18.8	18.1	18.1	18.2
Total	14.5	16.2	12.7	12.1	13.3	12.9	12.7
Military/Aerospace	2.9	1.2	-6.8	6.1	3.9	3.4	4.3

Source: Dataquest (May 1991)

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Table 4k
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Transportation
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Entertainment	510	490	442	411	453	463	489	498	-7.0	2.4
Vehicle Controls	377	397	463	480	615	775	932	1,015	3.7	17.0
Body Controls	42	57	74	77	91	105	115	123	4.1	10.7
Driver Information	703	710	705	681	743	773	818	853	-3.4	3.9
Powertrain	2,124	2,073	1,875	1,803	1,973	2,031	2,135	2,216	-3.8	3.4
Safety & Convenience	376	426	556	572	659	849	935	1,016	2.9	12.8
Transportation—Total[1,2]	4,132	4,153	4,115	4,024	4,534	4,996	5,424	5,721	-2.2	6.8

[1]Valued at factory revenue; previously valued at end-user cost.
[2]Includes only value of electronic modules, sensors, and actuators; does not include value of wiring and other electromechanical parts.
Source: Dataquest (May 1991)

Table 4l
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company:	All
Product:	Transportation
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1989	1990	1991	1992	1993	1994	1995
Entertainment	-3.9	-9.8	-7.0	10.2	2.2	5.6	1.8
Vehicle Controls	5.3	16.6	3.7	28.1	26.0	20.3	8.9
Body Controls	35.7	29.8	4.1	18.2	15.4	9.5	7.0
Driver Information	1.0	-.7	-3.4	9.1	4.0	5.8	4.3
Powertrain	-2.4	-9.6	-3.8	9.4	2.9	5.1	3.8
Safety & Convenience	13.3	30.5	2.9	15.2	28.8	10.1	8.7
Transportation—Total[1,2]	.5	-.9	-2.2	12.7	10.2	8.6	5.5

[1]Valued at factory revenue; previously valued at end-user cost.
[2]Includes only value of electronic modules, sensors, and actuators; does not include value of wiring and other electromechanical parts.
Source: Dataquest (May 1991)

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Table 5a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Data Processing
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
North America	73,428	78,717	82,851	86,968	93,584	100,146	106,665	113,558	5.0	6.5
Japan	45,638	47,942	46,625	54,197	59,485	64,817	68,021	72,913	16.2	9.4
Europe	21,353	26,375	28,151	32,959	38,167	43,055	48,029	54,182	17.1	14.0
Asia/Pacific-ROW	22,707	24,954	27,356	31,934	36,428	41,155	46,424	52,122	16.7	13.8
Worldwide Total	163,126	177,988	184,983	206,058	227,664	249,173	269,139	292,775	11.4	9.6

Source: Dataquest (May 1991)

Table 5b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Data Processing
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
North America	7.2	5.3	5.0	7.6	7.0	6.5	6.5
Japan	5.0	-2.7	16.2	9.8	9.0	4.9	7.2
Europe	23.5	6.7	17.1	15.8	12.8	11.6	12.8
Asia/Pacific-ROW	9.9	9.6	16.7	14.1	13.0	12.8	12.3
Worldwide Total	9.1	3.9	11.4	10.5	9.4	8.0	8.8

Source: Dataquest (May 1991)

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Table 5c
Electronic Equipment Production Forecast
(Percent of Worldwide Total)

Company: All
Product: Data Processing
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	45.0	44.2	44.8	42.2	41.1	40.2	39.6	38.8
Japan	28.0	26.9	25.2	26.3	26.1	26.0	25.3	24.9
Europe	13.1	14.8	15.2	16.0	16.8	17.3	17.8	18.5
Asia/Pacific-ROW	13.9	14.0	14.8	15.5	16.0	16.5	17.2	17.8
Worldwide Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

Table 5d
Electronic Equipment Production Forecast
(Percent of Regional Total)

Company: All
Product: Data Processing
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	35.5	35.7	36.3	37.4	37.5	37.7	38.1	38.3
Japan	31.3	32.6	30.9	31.6	32.1	33.1	33.5	34.0
Europe	15.6	17.7	17.6	18.9	20.1	20.8	21.4	22.0
Asia/Pacific-ROW	38.2	38.3	37.0	38.4	37.9	38.1	38.6	38.8
Worldwide Total	29.7	30.6	30.2	31.2	31.6	32.1	32.5	32.9

Source: Dataquest (May 1991)

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Table 6a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Communications
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
North America	25,409	28,227	30,188	32,520	35,408	37,972	40,184	42,614	7.7	7.1
Japan	20,008	19,109	20,826	24,070	25,952	27,894	29,186	31,232	15.6	8.4
Europe	28,084	30,925	34,515	38,074	41,587	45,366	48,607	53,490	10.3	9.2
Asia/Pacific-ROW	8,230	8,945	10,455	11,813	13,535	15,371	17,111	19,417	13.0	13.2
Worldwide Total	81,731	87,206	95,984	106,477	116,482	126,603	135,088	146,753	10.9	8.9

Source: Dataquest (May 1991)

Table 6b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Communications
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
North America	11.1	6.9	7.7	8.9	7.2	5.8	6.0
Japan	-4.5	9.0	15.6	7.8	7.5	4.6	7.0
Europe	10.1	11.6	10.3	9.2	9.1	7.1	10.0
Asia/Pacific-ROW	8.7	16.9	13.0	14.6	13.6	11.3	13.5
Worldwide Total	6.7	10.1	10.9	9.4	8.7	6.7	8.6

Source: Dataquest (May 1991)

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Table 6c
Electronic Equipment Production Forecast
(Percent of Worldwide Total)

Company: All
Product: Communications
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	31.1	32.4	31.5	30.5	30.4	30.0	29.7	29.0
Japan	24.5	21.9	21.7	22.6	22.3	22.0	21.6	21.3
Europe	34.4	35.5	36.0	35.8	35.7	35.8	36.0	36.4
Asia/Pacific-ROW	10.1	10.3	10.9	11.1	11.6	12.1	12.7	13.2
Worldwide Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

Table 6d
Electronic Equipment Production Forecast
(Percent of Regional Total)

Company: All
Product: Communications
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	12.3	12.8	13.2	14.0	14.2	14.3	14.3	14.4
Japan	13.7	13.0	13.8	14.1	14.0	14.2	14.4	14.5
Europe	20.5	20.7	21.6	21.9	21.9	21.9	21.7	21.7
Asia/Pacific-ROW	13.9	13.7	14.1	14.2	14.1	14.2	14.2	14.5
Worldwide Total	14.9	15.0	15.7	16.1	16.2	16.3	16.3	16.5

Source: Dataquest (May 1991)

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Table 7a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Industrial
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
North America	30,385	32,386	33,690	35,233	37,834	40,704	43,254	46,062	4.6	6.5
Japan	19,885	22,065	22,507	25,459	27,954	30,351	32,076	34,235	13.1	8.8
Europe	31,425	31,378	33,920	36,282	38,874	41,717	44,125	47,184	7.0	6.8
Asia/Pacific-ROW	2,214	2,433	2,920	3,369	3,855	4,313	4,800	5,236	15.4	12.4
Worldwide Total	83,909	88,262	93,037	100,343	108,517	117,085	124,255	132,717	7.9	7.4

Source: Dataquest (May 1991)

Table 7b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Industrial
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
North America	6.6	4.0	4.6	7.4	7.6	6.3	6.5
Japan	11.0	2.0	13.1	9.8	8.6	5.7	6.7
Europe	-.1	8.1	7.0	7.1	7.3	5.8	6.9
Asia/Pacific-ROW	9.9	20.0	15.4	14.4	11.9	11.3	9.1
Worldwide Total	5.2	5.4	7.9	8.1	7.9	6.1	6.8

Source: Dataquest (May 1991)

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Table 7c
Electronic Equipment Production Forecast
(Percent of Worldwide Total)

Company: All
Product: Industrial
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	36.2	36.7	36.2	35.1	34.9	34.8	34.8	34.7
Japan	23.7	25.0	24.2	25.4	25.8	25.9	25.8	25.8
Europe	37.5	35.6	36.5	36.2	35.8	35.6	35.5	35.6
Asia/Pacific-ROW	2.6	2.8	3.1	3.4	3.6	3.7	3.9	3.9
Worldwide Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

Table 7d
Electronic Equipment Production Forecast
(Percent of Regional Total)

Company: All
Product: Industrial
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	14.7	14.7	14.7	15.1	15.2	15.3	15.4	15.6
Japan	13.6	15.0	14.9	14.9	15.1	15.5	15.8	15.9
Europe	23.0	21.0	21.2	20.8	20.4	20.2	19.7	19.2
Asia/Pacific-ROW	3.7	3.7	3.9	4.1	4.0	4.0	4.0	3.9
Worldwide Total	15.3	15.2	15.2	15.2	15.0	15.1	15.0	14.9

Source: Dataquest (May 1991)

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Table 8a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Consumer
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
North America	15,454	17,081	17,005	17,396	18,370	19,236	20,145	20,974	2.3	4.3
Japan	54,716	51,703	54,007	60,202	63,854	64,249	64,824	66,736	11.5	4.3
Europe	30,752	34,322	37,282	40,341	43,661	47,327	51,707	57,355	8.2	9.0
Asia/Pacific-ROW	21,743	23,893	27,773	29,992	35,413	39,349	43,196	47,649	8.0	11.4
Worldwide Total	122,665	126,999	136,067	147,931	161,298	170,161	179,872	192,714	8.7	7.2

Source: Dataquest (May 1991)

Table 8b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Consumer
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
North America	10.5	-.4	2.3	5.6	4.7	4.7	4.1
Japan	-5.5	4.5	11.5	6.1	.6	.9	2.9
Europe	11.6	8.6	8.2	8.2	8.4	9.3	10.9
Asia/Pacific-ROW	9.9	16.2	8.0	18.1	11.1	9.8	10.3
Worldwide Total	3.5	7.1	8.7	9.0	5.5	5.7	7.1

Source: Dataquest (May 1991)

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Table 8c
Electronic Equipment Production Forecast
(Percent of Worldwide Total)

Company: All
Product: Consumer
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	12.6	13.4	12.5	11.8	11.4	11.3	11.2	10.9
Japan	44.6	40.7	39.7	40.7	39.6	37.8	36.0	34.6
Europe	25.1	27.0	27.4	27.3	27.1	27.8	28.7	29.8
Asia/Pacific-ROW	17.7	18.8	20.4	20.3	22.0	23.1	24.0	24.7
Worldwide Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

Table 8d
Electronic Equipment Production Forecast
(Percent of Regional Total)

Company: All
Product: Consumer
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	7.5	7.7	7.4	7.5	7.4	7.2	7.2	7.1
Japan	37.5	35.2	35.8	35.1	34.5	32.8	31.9	31.1
Europe	22.5	23.0	23.3	23.2	23.0	22.9	23.1	23.3
Asia/Pacific-ROW	36.6	36.7	37.6	36.1	36.9	36.4	35.9	35.5
Worldwide Total	22.3	21.8	22.2	22.4	22.4	21.9	21.7	21.6

Source: Dataquest (May 1991)

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Table 9a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Military/Aerospace
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
North America	58,179	59,876	60,569	56,476	59,934	62,275	64,419	67,195	-6.8	2.1
Japan	1,101	1,239	1,356	1,468	1,616	1,785	1,971	2,169	8.3	9.8
Europe	22,190	22,817	22,112	21,847	22,327	22,863	23,549	24,350	-1.2	1.9
Asia/Pacific-ROW	3,134	3,281	3,583	3,907	4,318	5,000	5,507	5,989	9.0	10.8
Worldwide Total	84,604	87,213	87,620	83,698	88,195	91,923	95,446	99,703	-4.5	2.6

Source: Dataquest (May 1991)

Table 9b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Military/Aerospace
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
North America	2.9	1.2	-6.8	6.1	3.9	3.4	4.3
Japan	12.5	9.4	8.3	10.1	10.5	10.4	10.0
Europe	2.8	-3.1	-1.2	2.2	2.4	3.0	3.4
Asia/Pacific-ROW	4.7	9.2	9.0	10.5	15.8	10.1	8.8
Worldwide Total	3.1	.5	-4.5	5.4	4.2	3.8	4.5

Source: Dataquest (May 1991)

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Table 9c
Electronic Equipment Production Forecast
(Percent of Worldwide Total)

Company:	All
Product:	Military/Aerospace
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	68.8	68.7	69.1	67.5	68.0	67.7	67.5	67.4
Japan	1.3	1.4	1.5	1.8	1.8	1.9	2.1	2.2
Europe	26.2	26.2	25.2	26.1	25.3	24.9	24.7	24.4
Asia/Pacific-ROW	3.7	3.8	4.1	4.7	4.9	5.4	5.8	6.0
Worldwide Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

Table 9d
Electronic Equipment Production Forecast
(Percent of Regional Total)

Company:	All
Product:	Military/Aerospace
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	28.1	27.2	26.5	24.3	24.0	23.5	23.0	22.7
Japan	.8	.8	.9	.9	.9	.9	1.0	1.0
Europe	16.2	15.3	13.8	12.5	11.7	11.0	10.5	9.9
Asia/Pacific-ROW	5.3	5.0	4.8	4.7	4.5	4.6	4.6	4.5
Worldwide Total	15.4	15.0	14.3	12.7	12.2	11.8	11.5	11.2

Source: Dataquest (May 1991)

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Table 10a
Electronic Equipment Production Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Transportation
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
North America	4,131	4,151	4,115	4,024	4,535	4,996	5,424	5,721	-2.2	6.8
Japan	4,621	5,008	5,596	5,900	6,407	6,768	7,061	7,429	5.4	5.8
Europe	3,052	3,568	4,061	4,747	5,523	6,670	8,219	9,551	16.9	18.7
Asia/Pacific-ROW	1,392	1,625	1,852	2,124	2,451	2,856	3,296	3,780	14.7	15.3
Worldwide Total	13,196	14,352	15,624	16,795	18,916	21,290	24,000	26,481	7.5	11.1

Source: Dataquest (May 1991)

Table 10b
Electronic Equipment Production Forecast
(Annual Growth in Percent)

Company: All
Product: Transportation
Region of Production: Each
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1989	1990	1991	1992	1993	1994	1995
North America	.5	-.9	-2.2	12.7	10.2	8.6	5.5
Japan	8.4	11.7	5.4	8.6	5.6	4.3	5.2
Europe	16.9	13.8	16.9	16.3	20.8	23.2	16.2
Asia/Pacific-ROW	16.7	14.0	14.7	15.4	16.5	15.4	14.7
Worldwide	8.8	8.9	7.5	12.6	12.6	12.7	10.3

Source: Dataquest (May 1991)

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Table 10c
Electronic Equipment Production Forecast
(Percent of Worldwide Total)

Company:	All
Product:	Transportation
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	31.3	28.9	26.3	24.0	24.0	23.5	22.6	21.6
Japan	35.0	34.9	35.8	35.1	33.9	31.8	29.4	28.1
Europe	23.1	24.9	26.0	28.3	29.2	31.3	34.2	36.1
Asia/Pacific-ROW	10.5	11.3	11.9	12.6	13.0	13.4	13.7	14.3
Worldwide Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (May 1991)

Table 10d
Electronic Equipment Production Forecast
(Percent of Regional Total)

Company:	All
Product:	Transportation
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
North America	2.0	1.9	1.8	1.7	1.8	1.9	1.9	1.9
Japan	3.2	3.4	3.7	3.4	3.5	3.5	3.5	3.5
Europe	2.2	2.4	2.5	2.7	2.9	3.2	3.7	3.9
Asia/Pacific-ROW	2.3	2.5	2.5	2.6	2.6	2.6	2.7	2.8
Worldwide Total	2.4	2.5	2.5	2.5	2.6	2.7	2.9	3.0

Source: Dataquest (May 1991)

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Table 11
Electronic Equipment Production Forecast
(Factory Cost Revenue in Billions of Yen)

Company: All
Product: Each
Region of Production: Japan
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Data Processing	5,933	6,616	6,715	7,256	7,966	8,679	9,108	9,764	8.1	7.8
Communications	2,599	2,637	2,999	3,224	3,475	3,734	3,908	4,182	7.5	6.9
Industrial	2,585	3,045	3,242	3,410	3,743	4,065	4,294	4,583	5.2	7.2
Consumer	7,113	7,135	7,777	8,062	8,549	8,603	8,679	8,935	3.7	2.8

Source: Dataquest (May 1991)

Table 12
Electronic Equipment Production Forecast
(End-User Revenue in Millions of Dollars)

Company: All
Product: Each
Region of Production: Europe
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Data Processing	40,746	49,332	52,711	61,173	70,465	78,933	87,852	98,901	16.1	13.4
Communications	31,595	34,790	38,830	42,832	46,785	51,037	54,681	60,177	10.3	9.2
Industrial	31,426	31,378	33,920	36,282	38,874	41,717	44,126	47,184	7.0	6.8
Consumer	38,441	42,902	46,601	50,426	54,575	59,157	64,635	71,692	8.2	9.0

Source: Dataquest (May 1991)

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Semiconductor Consumption and Shipment Forecast

May 1991

Source:
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Semiconductor Consumption and Shipment Forecast

Introduction

Semiconductor consumption and shipment data comprise a set of detailed tables that estimate the size of the semiconductor total available market (TAM) worldwide and for four major geographical regions for the years 1985 through 1995 and 2000. Semiconductor consumption and shipment tables contain both historical data and forecasts. Historical data begin with 1985 and end with 1990, while forecast data provide annual market size estimates for 1991 through 1995, with additional estimates for 2000. Below is a list of tables detailing the type of data, region, time period, and units of measure.

Each table gives estimates of semiconductor revenue or shipments listed by the major semiconductor device product categories. In these tables, semiconductor components are divided into three major product groups: integrated circuits, discrete devices, and optoelectronic devices. These groups are divided into a number of subgroups, some of which are segmented further.

Definitions and Conventions

Dataquest uses a common manufacturer base for all data tables. This base includes all suppliers to the merchant semiconductor market. It includes aggregate revenue estimates for North American companies that manufacture devices solely for the benefit of the parent company, such as Delco, IBM, and Unisys. Also included are companies that actively market semiconductor devices to the merchant market as well as to other divisions of their own companies. For such companies, both external and internal shipments are included. Devices that are used internally are valued at current market prices.

List of Tables

Table	Region Covered	Years	Units
0	Japan and Western Europe Exchange Rates	1970-1989	Various
1a	Worldwide Market	1985-1990	Dollars
1b	Worldwide Market	1985-1990	Percent
1c	Worldwide Market	1991-1995; 2000	Dollars
1d	Worldwide Market	1991-1995; 2000	Percent
2a	North American Market	1985-1990	Dollars
2b	North American Market	1985-1990	Percent
2c	North American Market	1991-1995; 2000	Dollars
2d	North American Market	1991-1995; 2000	Percent
3a	Japanese Market	1985-1990	Dollars
3b	Japanese Market	1985-1990	Percent
3c	Japanese Market	1991-1995; 2000	Dollars
3d	Japanese Market	1991-1995; 2000	Percent
4a	Japanese Market	1985-1990	Yen
4b	Japanese Market	1985-1990	Percent
4c	Japanese Market	1991-1995; 2000	Yen
4d	Japanese Market	1991-1995; 2000	Percent

(Continued)

List of Tables (Continued)

Table	Region Covered	Years	Units
5a	Western European Market	1985-1990	Dollars
5b	Western European Market	1985-1990	Percent
5c	Western European Market	1991-1995; 2000	Dollars
5d	Western European Market	1991-1995; 2000	Percent
6a	Asia/Pacific-ROW Market	1985-1990	Dollars
6b	Asia/Pacific-ROW Market	1985-1990	Percent
6c	Asia/Pacific-ROW Market	1991-1995; 2000	Dollars
6d	Asia/Pacific-ROW Market	1991-1995; 2000	Percent
7a	Worldwide Average Selling Prices	1985-1990	Dollars
7b	Worldwide Average Selling Prices	1985-1990	Percent
7c	Worldwide Average Selling Prices	1991-1995; 2000	Dollars
7d	Worldwide Average Selling Prices	1991-1995; 2000	Percent
8a	Worldwide Shipments	1985-1990	Units
8b	Worldwide Shipments	1985-1990	Percent
8c	Worldwide Shipments	1991-1995; 2000	Units
8d	Worldwide Shipments	1991-1995; 2000	Percent

Consumption—Dataquest defines consumption as the purchase of a semiconductor device or devices. This definition must be differentiated from actual use of the device in a final product. A regional market size includes all devices sold to or shipped to that region, i.e., the TAM in that region.

Hybrids—In earlier consumption data, hybrid devices were included as a separate segment of integrated circuits. Hybrid devices manufactured by semiconductor companies are now included in the most appropriate product segment, usually the analog segment.

The manufacturer base, product group definitions, and guidelines for including value of output that we have used in our tables may differ from those used in other studies of this type. Our base is nearly the same as that used by the World Semiconductor Trade Statistics (WSTS) program, with the following exceptions:

- Dataquest includes all of AT&T's semiconductor revenue, both merchant and captive.
- Dataquest includes—and has included all along—nonrecurring engineering (NRE) charges associated with application-specific integrated circuit (ASIC) revenue. (This applies to both the bipolar digital and MOS digital logic categories.)
- Dataquest includes the revenue generated by sales of standalone circuit design software, sold by certain U.S. manufacturers of ASIC logic devices.
- Dataquest includes Signetics revenue with that of its parent company, Netherlands-based N.V. Philips.
- Dataquest includes revenue for Taiwanese semiconductor manufacturers.
- Dataquest includes revenue for three Japanese companies not included by WSTS until 1990: NMB Semiconductor, Seiko-Epson, and Yamaha.
- As noted herein, Dataquest includes hybrid revenue in the analog category.

Further information on the above points is available through Dataquest's Client Inquiry Center at (408) 437-8099.

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Regions—North America is defined as including both the United States and Canada. Latin America, including Mexico, is considered part of the Asia/Pacific-ROW category. Asia/Pacific includes South Korea, Taiwan, Hong Kong, Singapore, and China. Western Europe includes Austria, Belgium, Germany, France, Italy, Luxembourg, the Netherlands, the Scandinavian countries (Denmark, Finland, Norway, Sweden), Spain, the United Kingdom, and the rest of Europe. Japan, the fourth region, is the only single-country region.

Data Sources

The historical information presented in the consumption and shipment data has been consolidated from a variety of sources, each of which focuses on a specific part of the market. These sources include the following:

- World Semiconductor Trade Statistics (WSTS) data, and Dataquest's estimates of regional company sales are used to determine shipments to North America.
- Japanese trade statistics compiled and published by the Ministry of Finance (MOF) and the Ministry of International Trade and Industry (MITI), WSTS data, and Dataquest's estimates of regional company sales are used to determine shipments to Japan.
- For Western European markets, marketing statistics from WSTS data and Dataquest's estimates of regional company sales are used to determine market size.
- In Asia/Pacific-ROW, the major published sources used to estimate market size are WSTS data and Dataquest's estimates of company shipments into the region.

Dataquest believes that the estimates presented here are the most accurate and meaningful generally available today. The sources of the data and the guidelines for the forecasts presented in the tables are as follows:

- Dataquest's own forecasts of electronic equipment production and semiconductor I/O ratios
- Unit shipments or revenue (or both) published by major industry participants, both in the United States and abroad
- Estimates presented by knowledgeable and reliable industry spokespersons
- Government data or trade association data such as those from the Electronics Industry Association (EIA), MITI, WSTS, and the U.S. Department of Commerce
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users
- Relevant projected world economic data

Accuracy

The tables presented here represent Dataquest estimates that we believe are reasonably accurate. Where we have no reasonable estimate, none is given. A zero in a table represents an estimate.

Valuation of Consumption

Regional market size is expressed in U.S. dollars (with the Japanese market also expressed in yen). To make the tables in this study useful in comparing different regions, it is necessary to express all values in a common currency, and we chose the U.S. dollar for convenience. However, the choice of the U.S. dollar (or any single currency, for that matter) as the currency basis for the tables brings with it some problems that require the readers' careful consideration in interpreting the data.

Inflation

All countries that participate significantly in international semiconductor markets suffered from an overall price inflation in the 1980s, continuing into the 1990s. As a consequence, the dollar in a given year is not truly comparable with the dollar in any preceding year. Consumer and wholesale price indices and GNP deflators all measure price changes in various composite "market baskets" of goods. However, there is no price index that measures price changes of material, equipment, and labor inputs to the semiconductor industry. Indeed, the "mix" is changing so rapidly that what is used this year was sometimes unavailable last year, at any price. Nor is there a composite price index that measures price changes in aggregate semiconductor product. In an industry noted for its deflationary trends, this latter effect would tend to make the component purchaser's dollar worth more as time passed, in terms of purchasing ability.

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We have made no adjustments in the historical data to account for these inflationary and deflationary effects. The data are expressed in current dollars (dollars that include the inflation rate and exchange rates of the given year) for all historical data; comparisons between different years must be interpreted accordingly.

Average Selling Prices

When considering the worldwide average selling prices (ASPs) for semiconductor components, one must look at the price per function of a circuit, the complexity of the circuit, and the product mix according to this increasing complexity. It is true that one characteristic of the semiconductor industry is that the price per function for integrated circuits has been dropping an average of 30 percent per year for the last 15 years. At the same time, circuits have become denser, resulting in an overall increase in the price of a device with a decreasing cost per function. Thus, Tables 7a through 7d show the worldwide ASPs increasing after many years of decreasing, due to the move toward higher-complexity devices. There are also regional differences in ASPs due to regional competition differences and the varying regional product consumption mix. The worldwide ASP is truly an aggregate measure and may differ significantly from ASPs in any specific market at any point in time.

Exchange Rates

Construction of the West European tables involves combining data from many countries, each of which has different and changing exchange rates. Dataquest uses Annual Foreign Exchange Rates for each year as published by The International Monetary Fund and the *Wall Street Journal*. As far as possible, we prepare our estimates in terms of local currencies before conversion to U.S. dollars. The exchange rates for major currencies can be found in Table 0 at the end of this introduction.

Japanese market size is originally expressed in yen. The Japanese data published in this study are expressed in both dollars (Tables 3a, 3b, 3c, and 3d) and in yen (Tables 4a, 4b, 4c, and 4d). The yen/dollar exchange rate used for each year can be found in Table 0. Because of the fluctuations in the exchange rate for the yen, the dollar values given tend to distort the growth rate of the Japanese market, but they do provide a useful basis for regional market size comparisons. However, the data in yen give a better picture of the real growth in the Japanese market.

Forecast

As mentioned previously, historical data are expressed in current dollars or dollars that include the given year's inflation rate and exchange rates. However, the revenue forecasts use constant dollars and exchange rates, with no allowance for inflation or variations in the rates of exchange between countries. All estimates for 1991 and beyond are made as if 1991 monetary conditions will continue through 2000 and, therefore, show the absolute year-to-year growth during this period.

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Table 0
Foreign Exchange Rates

Year	Yrly/Qtrly	Japan (Yen per US$)	France (US$ per Franc)	Germany (US$ per Deutsche Mark)	United Kingdom (US$ per Pound Sterling)
1970	YR	358	0.18	0.27	2.38
1971	YR	343	0.18	0.29	2.44
1972	YR	302	0.20	0.31	2.50
1973	YR	269	0.22	0.37	2.44
1974	YR	292	0.21	0.39	2.33
1975	YR	297	0.23	0.41	2.22
1976	YR	296	0.21	0.40	1.82
1977	YR	269	0.20	0.43	1.75
1978	YR	210	0.22	0.50	1.92
1979	YR	219	0.24	0.55	2.13
1980	YR	227	0.24	0.55	2.33
1981	YR	221	0.18	0.44	2.04
1982	YR	248	0.15	0.41	1.75
1983	YR	235	0.13	0.39	1.52
1984	YR	237	0.11	0.35	1.33
1985	YR	238	0.11	0.34	1.30
1986	YR	167	0.14	0.46	1.47
1987	YR	144	0.17	0.56	1.64
1988	YR	130	0.17	0.57	1.79
1989	YR	138	0.16	0.53	1.50
1990	YR	144	0.18	0.62	1.79
Q191	QTR	134	0.19	0.65	1.91

Source: The International Monetary Fund Financial Times, Dataquest (May 1991)

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Table 1a
Worldwide Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	27,116	33,729	41,478	54,521	61,454	62,772
North American Captives	2,773	2,895	3,227	3,662	4,241	4,547
Total Semiconductor	24,343	30,834	38,251	50,859	57,213	58,225
Total IC	18,552	23,618	29,887	41,068	46,924	47,303
Bipolar Digital	3,684	4,325	4,760	5,200	4,510	4,440
Memory	589	606	621	689	540	459
Logic	3,095	3,719	4,139	4,511	3,970	3,981
MOS Digital	10,103	12,815	17,473	26,988	33,024	32,292
Memory	3,817	4,511	6,056	11,692	16,361	13,091
Micro	2,745	3,489	5,108	7,144	8,202	10,068
Logic	3,541	4,815	6,309	8,152	8,461	9,133
Analog	4,765	6,478	7,654	8,880	9,390	10,571
Total Discrete	4,578	5,730	6,655	7,612	7,662	8,235
Total Optoelectronic	1,213	1,486	1,709	2,179	2,627	2,687

Source: Dataquest (May 1991)

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Table 1b
Worldwide Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-13.4	24.4	23.0	31.4	12.7	2.1	18.3
North American Captives	10.9	4.4	11.5	13.5	15.8	7.2	10.4
Total Semiconductor	-15.5	26.7	24.1	33.0	12.5	1.8	19.1
Total IC	-18.0	27.3	26.5	37.4	14.3	.8	20.6
Bipolar Digital	-23.0	17.4	10.1	9.2	-13.3	-1.6	3.8
Memory	-23.9	2.9	2.5	11.0	-21.6	-15.0	-4.9
Logic	-22.8	20.2	11.3	9.0	-12.0	.3	5.2
MOS Digital	-22.0	26.8	36.3	54.5	22.4	-2.2	26.2
Memory	-38.7	18.2	34.2	93.1	39.9	-20.0	28.0
Micro	-15.0	27.1	46.4	39.9	14.8	22.8	29.7
Logic	1.4	36.0	31.0	29.2	3.8	7.9	20.9
Analog	-2.5	35.9	18.2	16.0	5.7	12.6	17.3
Total Discrete	-8.2	25.2	16.1	14.4	.7	7.5	12.5
Total Optoelectronic	-.7	22.5	15.0	27.5	20.6	2.3	17.2

Source: Dataquest (May 1991)

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Table 1c
Worldwide Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	71,807	83,745	97,321	107,632	114,222	199,971
North American Captives	5,584	6,556	7,518	8,407	8,691	14,610
Total Semiconductor	66,223	77,189	89,803	99,225	105,531	185,361
Total IC	54,103	64,232	75,522	83,934	89,840	164,196
Bipolar Digital	4,624	4,679	4,683	4,480	4,256	3,272
Memory	440	434	433	402	375	248
Logic	4,184	4,245	4,250	4,078	3,881	3,024
MOS Digital	37,709	46,294	55,628	62,243	66,906	130,228
Memory	14,974	18,798	23,001	26,078	28,283	56,891
Micro	12,118	14,907	17,917	20,076	21,604	44,069
Logic	10,617	12,589	14,710	16,089	17,019	29,268
Analog	11,770	13,259	15,211	17,211	18,678	30,696
Total Discrete	9,112	9,703	10,721	11,342	11,513	15,046
Total Optoelectronic	3,008	3,254	3,560	3,949	4,178	6,119

Source: Dataquest (May 1991)

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Table 1d
Worldwide Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	14.4	16.6	16.2	10.6	6.1	12.7	11.9
North American Captives	22.8	17.4	14.7	11.8	3.4	13.8	10.9
Total Semiconductor	13.7	16.6	16.3	10.5	6.4	12.6	11.9
Total IC	14.4	18.7	17.6	11.1	7.0	13.7	12.8
Bipolar Digital	4.1	1.2	.1	-4.3	-5.0	-.8	-5.1
Memory	-4.1	-1.4	-.2	-7.2	-6.7	-4.0	-7.9
Logic	5.1	1.5	.1	-4.0	-4.8	-.5	-4.9
MOS Digital	16.8	22.8	20.2	11.9	7.5	15.7	14.2
Memory	14.4	25.5	22.4	13.4	8.5	16.7	15.0
Micro	20.4	23.0	20.2	12.1	7.6	16.5	15.3
Logic	16.2	18.6	16.8	9.4	5.8	13.3	11.5
Analog	11.3	12.7	14.7	13.1	8.5	12.1	10.4
Total Discrete	10.6	6.5	10.4	5.8	1.5	6.9	5.5
Total Optoelectronic	11.9	8.2	9.4	10.9	5.8	9.2	7.9

Source: Dataquest (May 1991)

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Table 2a
North American Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	11,663	13,171	15,454	18,789	21,348	20,844
North American Captives	2,243	2,327	2,596	2,945	3,411	3,458
Total Semiconductor	9,420	10,844	12,858	15,844	17,937	17,386
Total IC	7,757	8,986	10,886	13,815	15,909	15,387
Bipolar Digital	1,926	2,030	2,099	2,012	1,701	1,652
Memory	288	267	271	235	203	170
Logic	1,638	1,763	1,828	1,777	1,498	1,482
MOS Digital	4,322	4,912	6,738	9,606	11,682	11,025
Memory	1,753	1,775	2,497	4,298	6,163	4,655
Micro	1,258	1,362	2,012	2,707	2,972	3,563
Logic	1,311	1,775	2,229	2,601	2,547	2,807
Analog	1,509	2,044	2,049	2,197	2,526	2,710
Total Discrete	1,295	1,542	1,642	1,676	1,683	1,669
Total Optoelectronic	368	316	330	353	345	330

Source: Dataquest (May 1991)

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Table 2b
North American Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-22.4	12.9	17.3	21.6	13.6	-2.4	12.3
North American Captives	10.7	3.7	11.6	13.4	15.8	1.4	9.0
Total Semiconductor	-27.6	15.1	18.6	23.2	13.2	-3.1	13.0
Total IC	-30.0	15.8	21.1	26.9	15.2	-3.3	14.7
Bipolar Digital	-31.7	5.4	3.4	-4.1	-15.5	-2.9	-3.0
Memory	-34.7	-7.3	1.5	-13.3	-13.6	-16.3	-10.0
Logic	-31.1	7.6	3.7	-2.8	-15.7	-1.1	-2.0
MOS Digital	-33.5	13.7	37.2	42.6	21.6	-5.6	20.6
Memory	-48.8	1.3	40.7	72.1	43.4	-24.5	21.6
Micro	-23.0	8.3	47.7	34.5	9.8	19.9	23.1
Logic	-9.1	35.4	25.6	16.7	-2.1	10.2	16.4
Analog	-14.6	35.5	.2	7.2	15.0	7.3	12.4
Total Discrete	-13.8	19.1	6.5	2.1	.4	-.8	5.2
Total Optoelectronic	-11.1	-14.1	4.4	7.0	-2.3	-4.3	-2.2

Source: Dataquest (May 1991)

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Table 2c
North American Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	22,918	26,235	30,343	33,112	34,448	53,614
North American Captives	4,157	4,849	5,533	6,217	6,447	10,837
Total Semiconductor	18,761	21,386	24,810	26,895	28,001	42,777
Total IC	16,692	19,198	22,404	24,394	25,557	40,005
Bipolar Digital	1,621	1,588	1,649	1,509	1,381	987
Memory	149	138	134	118	104	50
Logic	1,472	1,450	1,515	1,391	1,277	937
MOS Digital	12,102	14,242	16,899	18,580	19,495	31,615
Memory	4,989	5,808	6,963	8,106	8,681	14,827
Micro	4,003	4,784	5,613	5,960	6,254	10,026
Logic	3,110	3,650	4,323	4,514	4,560	6,762
Analog	2,969	3,368	3,856	4,305	4,681	7,403
Total Discrete	1,733	1,823	2,014	2,089	2,039	2,307
Total Optoelectronic	336	365	392	412	405	465

Source: Dataquest (May 1991)

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Table 2d
North American Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	10.0	14.5	15.7	9.1	4.0	10.6	9.3
North American Captives	20.2	16.6	14.1	12.4	3.7	13.3	10.9
Total Semiconductor	7.9	14.0	16.0	8.4	4.1	10.0	8.8
Total IC	8.5	15.0	16.7	8.9	4.8	10.7	9.4
Bipolar Digital	-1.9	-2.0	3.8	-8.5	-8.5	-3.5	-6.5
Memory	-12.4	-7.4	-2.9	-11.9	-11.9	-9.4	-13.6
Logic	-.7	-1.5	4.5	-8.2	-8.2	-2.9	-6.0
MOS Digital	9.8	17.7	18.7	9.9	4.9	12.1	10.2
Memory	7.2	16.4	19.9	16.4	7.1	13.3	11.3
Micro	12.3	19.5	17.3	6.2	4.9	11.9	9.9
Logic	10.8	17.4	18.4	4.4	1.0	10.2	8.2
Analog	9.6	13.4	14.5	11.6	8.7	11.6	9.6
Total Discrete	3.8	5.2	10.5	3.7	-2.4	4.1	2.5
Total Optoelectronic	1.8	8.6	7.4	5.1	-1.7	4.2	2.8

Source: Dataquest (May 1991)

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Table 3a
Japanese Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	8,300	12,018	15,107	20,977	23,234	23,031
North American Captives	151	163	180	205	237	523
Total Semiconductor	8,149	11,855	14,927	20,772	22,997	22,508
Total IC	5,985	8,802	11,263	16,127	17,946	17,387
Bipolar Digital	824	1,295	1,523	1,906	1,750	1,800
Memory	136	169	227	348	246	209
Logic	688	1,126	1,296	1,558	1,504	1,591
MOS Digital	3,232	4,762	6,424	10,501	12,497	11,799
Memory	1,185	1,738	2,268	4,424	5,992	4,612
Micro	884	1,368	1,902	2,573	2,828	3,210
Logic	1,163	1,656	2,254	3,504	3,677	3,977
Analog	1,929	2,745	3,316	3,720	3,699	3,788
Total Discrete	1,621	2,242	2,693	3,282	3,321	3,392
Total Optoelectronic	543	811	971	1,363	1,730	1,729

Source: Dataquest (May 1991)

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Table 3b
Japanese Semiconductor Consumption
(Millions of Dollars)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR (%) 85-90
Total Including Captives	-6.8	44.8	25.7	38.9	10.8	-.9	22.6
North American Captives	11.9	7.9	10.4	13.9	15.6	120.7	28.2
Total Semiconductor	-7.1	45.5	25.9	39.2	10.7	-2.1	22.5
Total IC	-8.2	47.1	28.0	43.2	11.3	-3.1	23.8
Bipolar Digital	-13.7	57.2	17.6	25.1	-8.2	2.9	16.9
Memory	-16.6	24.3	34.3	53.3	-29.3	-15.0	9.0
Logic	-13.1	63.7	15.1	20.2	-3.5	5.8	18.3
MOS Digital	-10.7	47.3	34.9	63.5	19.0	-5.6	29.6
Memory	-25.0	46.7	30.5	95.1	35.4	-23.0	31.2
Micro	-9.7	54.8	39.0	35.3	9.9	13.5	29.4
Logic	9.4	42.4	36.1	55.5	4.9	8.2	27.9
Analog	-.6	42.3	20.8	12.2	-.6	2.4	14.4
Total Discrete	-7.7	38.3	20.1	21.9	1.2	2.1	15.9
Total Optoelectronic	8.4	49.4	19.7	40.4	26.9	-.1	26.1

Source: Dataquest (May 1991)

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Table 3c
Japanese Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	27,025	31,580	35,586	39,208	41,787	72,290
North American Captives	671	818	931	1,008	1,025	1,723
Total Semiconductor	26,354	30,762	34,655	38,200	40,762	70,567
Total IC	20,545	24,608	28,096	31,150	33,407	60,667
Bipolar Digital	2,030	2,158	2,142	2,131	2,098	1,685
Memory	222	233	240	237	233	180
Logic	1,808	1,925	1,902	1,894	1,865	1,505
MOS Digital	14,288	17,799	20,751	23,267	25,236	50,100
Memory	5,698	7,537	9,037	10,212	11,131	24,719
Micro	3,835	4,615	5,293	5,928	6,422	11,780
Logic	4,755	5,647	6,421	7,127	7,683	13,601
Analog	4,227	4,651	5,203	5,752	6,073	8,882
Total Discrete	3,827	4,017	4,242	4,467	4,601	5,816
Total Optoelectronic	1,982	2,137	2,317	2,583	2,754	4,084

Source: Dataquest (May 1991)

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Table 3d
Japanese Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	17.3	16.9	12.7	10.2	6.6	12.7	11.6
North American Captives	28.3	21.9	13.8	8.3	1.7	14.4	10.9
Total Semiconductor	17.1	16.7	12.7	10.2	6.7	12.6	11.6
Total IC	18.2	19.8	14.2	10.9	7.2	14.0	12.7
Bipolar Digital	12.8	6.3	-.7	-.5	-1.5	3.1	-4.3
Memory	6.2	5.0	3.0	-1.3	-1.7	2.2	-5.0
Logic	13.6	6.5	-1.2	-.4	-1.5	3.2	-4.2
MOS Digital	21.1	24.6	16.6	12.1	8.5	16.4	14.7
Memory	23.5	32.3	19.9	13.0	9.0	19.3	17.3
Micro	19.5	20.3	14.7	12.0	8.3	14.9	12.9
Logic	19.6	18.8	13.7	11.0	7.8	14.1	12.1
Analog	11.6	10.0	11.9	10.6	5.6	9.9	7.9
Total Discrete	12.8	5.0	5.6	5.3	3.0	6.3	4.8
Total Optoelectronic	14.6	7.8	8.4	11.5	6.6	9.8	8.2

Source: Dataquest (May 1991)

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Table 4a
Japanese Semiconductor Consumption
(Factory Revenue in Billions of Japanese Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	1,975.3	2,006.9	2,175.4	2,727.0	3,206.3	3,316.4
North American Captives	35.9	27.2	25.9	26.7	32.7	75.3
Total Semiconductor	1,939.4	1,979.7	2,149.5	2,700.3	3,173.6	3,241.1
Total IC	1,424.4	1,469.9	1,621.9	2,096.4	2,476.6	2,503.7
Bipolar Digital	196.1	216.2	219.3	247.7	241.5	259.2
Memory	32.4	28.2	32.7	45.2	33.9	30.1
Logic	163.7	188.0	186.6	202.5	207.6	229.1
MOS Digital	769.2	795.3	925.1	1,365.1	1,724.6	1,699.0
Memory	282.0	290.2	326.6	575.1	826.9	664.1
Micro	210.4	228.5	273.9	334.5	390.3	462.2
Logic	276.8	276.6	324.6	455.5	507.4	572.7
Analog	459.1	458.4	477.5	483.6	510.5	545.5
Total Discrete	385.8	374.4	387.8	426.7	458.3	488.4
Total Optoelectronic	129.2	135.4	139.8	177.2	238.7	249.0
Exchange Rate (Yen/US$)	238	167	144	130	138	144

Source: Dataquest (May 1991)

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Table 4b
Japanese Semiconductor Consumption
(Percent Change in Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-6.4	1.6	8.4	25.4	17.6	3.4	10.9
North American Captives	.0	.0	.0	.0	.0	.0	.0
Total Semiconductor	-6.7	2.1	8.6	25.6	17.5	2.1	10.8
Total IC	-7.8	3.2	10.3	29.3	18.1	1.1	11.9
Bipolar.Digital	-13.3	10.2	1.4	13.0	-2.5	7.3	5.7
Memory	-16.1	-13.0	16.0	38.2	-25.0	-11.2	-1.5
Logic	-12.8	14.8	-.7	8.5	2.5	10.4	7.0
MOS Digital	-10.4	3.4	16.3	47.6	26.3	-1.5	17.2
Memory	-24.6	2.9	12.5	76.1	43.8	-19.7	18.7
Micro	-9.3	8.6	19.9	22.1	16.7	18.4	17.0
Logic	9.9	-.1	17.4	40.3	11.4	12.9	15.7
Analog	-.2	-.2	4.2	1.3	5.6	6.9	3.5
Total Discrete	-7.3	-3.0	3.6	10.0	7.4	6.6	4.8
Total Optoelectronic	8.8	4.8	3.2	26.8	34.7	4.3	14.0

NA = Not available

Source: Dataquest (May 1991)

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Table 4c
Japanese Semiconductor Consumption
(Factory Revenue in Billions of Japanese Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	3,618.6	4,228.5	4,765.0	5,250.0	5,595.3	9,679.6
North American Captives	89.8	109.5	124.7	135.0	137.2	230.7
Total Semiconductor	3,528.8	4,119.0	4,640.3	5,115.0	5,458.1	9,448.9
Total IC	2,751.0	3,295.0	3,762.1	4,171.0	4,473.2	8,123.3
Bipolar Digital	271.8	289.0	286.8	285.3	280.9	225.6
Memory	29.7	31.2	32.1	31.7	31.2	24.1
Logic	242.1	257.8	254.7	253.6	249.7	201.5
MOS Digital	1,913.2	2,383.2	2,778.6	3,115.5	3,379.1	6,708.4
Memory	763.0	1,009.2	1,210.1	1,367.4	1,490.4	3,309.9
Micro	513.5	617.9	708.7	793.8	859.9	1,577.3
Logic	636.7	756.1	859.8	954.3	1,028.8	1,821.2
Analog	566.0	622.8	696.7	770.2	813.2	1,189.3
Total Discrete	512.4	537.9	568.0	598.1	616.1	778.8
Total Optoelectronic	265.4	286.1	310.2	345.9	368.8	546.8
Exchange Rate (Yen/US$)	133.9	133.9	133.9	133.9	133.9	133.9

Source: Dataquest (May 1991)

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Table 4d
Japanese Semiconductor Consumption
(Percent Change in Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	9.1	16.9	12.7	10.2	6.6	11.0	11.6
North American Captives	.0	.0	.0	.0	.0	.0	.0
Total Semiconductor	8.9	16.7	12.7	10.2	6.7	11.0	11.6
Total IC	9.9	19.8	14.2	10.9	7.2	12.3	12.7
Bipolar Digital	4.9	6.3	-.8	-.5	-1.5	1.6	-4.3
Memory	-1.3	5.1	2.9	-1.2	-1.6	.7	-5.0
Logic	5.7	6.5	-1.2	-.4	-1.5	1.7	-4.2
MOS Digital	12.6	24.6	16.6	12.1	8.5	14.7	14.7
Memory	14.9	32.3	19.9	13.0	9.0	17.5	17.3
Micro	11.1	20.3	14.7	12.0	8.3	13.2	12.9
Logic	11.2	18.8	13.7	11.0	7.8	12.4	12.1
Analog	3.8	10.0	11.9	10.5	5.6	8.3	7.9
Total Discrete	4.9	5.0	5.6	5.3	3.0	4.8	4.8
Total Optoelectronic	6.6	7.8	8.4	11.5	6.6	8.2	8.2

NA = Not available

Source: Dataquest (May 1991)

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Table 5a
European Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	5,174	5,992	6,949	9,003	10,348	11,227
North American Captives	379	405	451	512	593	566
Total Semiconductor	4,795	5,587	6,498	8,491	9,755	10,661
Total IC	3,615	4,116	4,840	6,669	7,794	8,326
Bipolar Digital	719	719	727	772	640	577
Memory	150	147	88	74	72	58
Logic	569	572	639	698	568	519
MOS Digital	1,933	2,270	2,761	4,364	5,458	5,403
Memory	745	813	854	1,797	2,548	2,154
Micro	486	574	805	1,212	1,469	1,836
Logic	702	883	1,102	1,355	1,441	1,413
Analog	963	1,127	1,352	1,533	1,696	2,346
Total Discrete	969	1,207	1,377	1,516	1,594	1,915
Total Optoelectronic	211	264	281	306	367	420

Source: Dataquest (May 1991)

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Table 5b
European Semiconductor Consumption
(Millions of Dollars)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR (%) 85-90
Total Including Captives	-.5	15.8	16.0	29.6	14.9	8.5	16.8
North American Captives	12.1	6.9	11.4	13.5	15.8	-4.6	8.4
Total Semiconductor	-1.4	16.5	16.3	30.7	14.9	9.3	17.3
Total IC	-3.1	13.9	17.6	37.8	16.9	6.8	18.2
Bipolar Digital	-3.0	.0	1.1	6.2	-17.1	-9.8	-4.3
Memory	4.2	-2.0	-40.1	-15.9	-2.7	-19.4	-17.3
Logic	-4.7	.5	11.7	9.2	-18.6	-8.6	-1.8
MOS Digital	-8.9	17.4	21.6	58.1	25.1	-1.0	22.8
Memory	-24.4	9.1	5.0	110.4	41.8	-15.5	23.7
Micro	3.2	18.1	40.2	50.6	21.2	25.0	30.5
Logic	5.4	25.8	24.8	23.0	6.3	-1.9	15.0
Analog	11.1	17.0	20.0	13.4	10.6	38.3	19.5
Total Discrete	2.9	24.6	14.1	10.1	5.1	20.1	14.6
Total Optoelectronic	10.5	25.1	6.4	8.9	19.9	14.4	14.8

Source: Dataquest (May 1991)

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Table 5c
European Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	13,030	15,305	18,367	20,508	21,983	41,690
North American Captives	756	889	1,054	1,182	1,219	2,050
Total Semiconductor	12,274	14,416	17,313	19,326	20,764	39,640
Total IC	9,634	11,542	14,002	15,818	17,138	34,417
Bipolar Digital	571	540	500	458	403	268
Memory	57	52	50	40	32	17
Logic	514	488	450	418	371	251
MOS Digital	6,462	8,155	10,264	11,703	12,757	28,000
Memory	2,570	3,346	4,293	4,667	5,140	11,269
Micro	2,225	2,873	3,706	4,447	4,847	11,762
Logic	1,667	1,936	2,265	2,589	2,770	4,969
Analog	2,601	2,847	3,238	3,657	3,978	6,149
Total Discrete	2,178	2,370	2,755	2,894	2,981	4,280
Total Optoelectronic	462	504	556	614	645	943

Source: Dataquest (May 1991)

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Table 5d
European Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	16.1	17.5	20.0	11.7	7.2	14.4	13.7
North American Captives	33.6	17.6	18.6	12.1	3.1	16.6	11.0
Total Semiconductor	15.1	17.5	20.1	11.6	7.4	14.3	13.8
Total IC	15.7	19.8	21.3	13.0	8.3	15.5	15.0
Bipolar Digital	-1.0	-5.4	-7.4	-8.4	-12.0	-6.9	-7.8
Memory	-1.7	-8.8	-3.8	-20.0	-20.0	-11.2	-11.9
Logic	-1.0	-5.1	-7.8	-7.1	-11.2	-6.5	-7.5
MOS Digital	19.6	26.2	25.9	14.0	9.0	18.7	17.0
Memory	19.3	30.2	28.3	8.7	10.1	19.0	17.0
Micro	21.2	29.1	29.0	20.0	9.0	21.4	19.4
Logic	18.0	16.1	17.0	14.3	7.0	14.4	12.4
Analog	10.9	9.5	13.7	12.9	8.8	11.1	9.1
Total Discrete	13.7	8.8	16.2	5.0	3.0	9.3	7.5
Total Optoelectronic	10.0	9.1	10.3	10.4	5.0	9.0	7.9

Source: Dataquest (May 1991)

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Table 6a
Asia/Pacific-Rest of World Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Asia/ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	1,979	2,548	3,968	5,752	6,524	7,670
North American Captives	0	0	0	0	0	0
Total Semiconductor	1,979	2,548	3,968	5,752	6,524	7,670
Total IC	1,195	1,714	2,898	4,457	5,275	6,203
Bipolar Digital	215	281	411	510	419	411
Memory	15	23	35	32	19	22
Logic	200	258	376	478	400	389
MOS Digital	616	871	1,550	2,517	3,387	4,065
Memory	134	185	437	1,173	1,658	1,670
Micro	117	185	389	652	933	1,459
Logic	365	501	724	692	796	936
Analog	364	562	937	1,430	1,469	1,727
Total Discrete	693	739	943	1,138	1,064	1,259
Total Optoelectronic	91	95	127	157	185	208

Source: Dataquest (May 1991)

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Table 6b
Asia/Pacific-Rest of World Semiconductor Consumption
(Millions of Dollars)

Company:	All
Product:	Each
Region of Consumption:	Asia/ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR (%) 85-90
Total Including Captives	-9.3	28.8	55.7	45.0	13.4	17.6	31.1
North American Captives	NM	NM	NM	NM	NM	NM	NM
Total Semiconductor	-9.3	28.8	55.7	45.0	13.4	17.6	31.1
Total IC	-6.7	43.4	69.1	53.8	18.4	17.6	39.0
Bipolar.Digital	-20.1	30.7	46.3	24.1	-17.8	-1.9	13.8
Memory	-42.3	53.3	52.2	-8.6	-40.6	15.8	8.0
Logic	-17.7	29.0	45.7	27.1	-16.3	-2.8	14.2
MOS Digital	-12.0	41.4	78.0	62.4	34.6	20.0	45.8
Memory	-42.7	38.1	136.2	168.4	41.3	.7	65.6
Micro	-19.3	58.1	110.3	67.6	43.1	56.4	65.6
Logic	13.7	37.3	44.5	-4.4	15.0	17.6	20.7
Analog	16.7	54.4	66.7	52.6	2.7	17.6	36.5
Total Discrete	-11.7	6.6	27.6	20.7	-6.5	18.3	12.7
Total Optoelectronic	-20.9	4.4	33.7	23.6	17.8	12.4	18.0

NM = Not meaningful

Source: Dataquest (May 1991)

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Table 6c
Asia/Pacific-Rest of World Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Asia/ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	8,834	10,625	13,025	14,804	16,004	32,377
North American Captives	0	0	0	0	0	0
Total Semiconductor	8,834	10,625	13,025	14,804	16,004	32,377
Total IC	7,232	8,884	11,020	12,572	13,738	29,107
Bipolar Digital	402	393	392	382	374	332
Memory	12	11	9	7	6	1
Logic	390	382	383	375	368	331
MOS Digital	4,857	6,098	7,714	8,693	9,418	20,513
Memory	1,717	2,107	2,708	3,093	3,331	6,076
Micro	2,055	2,635	3,305	3,741	4,081	10,501
Logic	1,085	1,356	1,701	1,859	2,006	3,936
Analog	1,973	2,393	2,914	3,497	3,946	8,262
Total Discrete	1,374	1,493	1,710	1,892	1,892	2,643
Total Optoelectronic	228	248	295	340	374	627

Source: Dataquest (May 1991)

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Table 6d
Asia/Pacific-Rest of World Semiconductor Consumption
(Percent Change)

Company: All
Product: Each
Region of Consumption: Asia/ROW
Distribution Channel: All
Application: All
Specification: All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	15.2	20.3	22.6	13.7	8.1	15.8	15.1
North American Captives	NM	NM	NM	NM	NM	NM	NM
Total Semiconductor	15.2	20.3	22.6	13.7	8.1	15.8	15.1
Total IC	16.6	22.8	24.0	14.1	9.3	17.2	16.2
Bipolar Digital	-2.2	-2.2	-.3	-2.6	-2.1	-1.9	-2.4
Memory	-45.5	-8.3	-18.2	-22.2	-14.3	-22.9	-30.1
Logic	.3	-2.1	.3	-2.1	-1.9	-1.1	-2.1
MOS Digital	19.5	25.6	26.5	12.7	8.3	18.3	16.8
Memory	2.8	22.7	28.5	14.2	7.7	14.8	12.8
Micro	40.8	28.2	25.4	13.2	9.1	22.8	20.8
Logic	15.9	25.0	25.4	9.3	7.9	16.5	14.4
Analog	14.2	21.3	21.8	20.0	12.8	18.0	15.9
Total Discrete	9.1	8.7	14.5	10.6	.0	8.5	6.9
Total Optoelectronic	9.6	8.8	19.0	15.3	10.0	12.5	10.9

NM = Not meaningful

Source: Dataquest (May 1991)

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Table 7a
Worldwide Semiconductor Average Selling Prices
(Factory ASP in U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Semiconductor	.30	.34	.33	.42	.42	.39
Total IC	1.05	1.09	1.18	1.32	1.45	1.33
Bipolar Digital	.71	.71	.69	.70	.70	.68
Memory						
Logic						
MOS Digital	1.64	1.63	1.94	2.38	2.65	2.32
Memory	2.59	2.41	3.09	4.87	5.88	4.43
Micro	3.14	3.13	3.56	4.15	3.77	4.28
Logic	.93	.99	1.12	1.13	1.13	1.06
Analog	.76	.84	.82	.72	.70	.70
Total Discrete	.08	.09	.08	.09	.08	.08
Total Optoelectronic	.22	.25	.28	.34	.27	.29

Source: Dataquest (May 1991)

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Table 7b
Worldwide Semiconductor Average Selling Prices
(Percent Change in Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Semiconductor	-15.7	13.2	-2.7	24.8	-.3	-5.1	5.4
Total IC	-4.4	3.5	8.5	11.6	10.0	-8.4	4.8
Bipolar Digital	9.2	.0	-2.8	1.4	.0	-2.9	-.9
Memory							
Logic							
MOS Digital	-16.0	-.5	18.6	23.0	11.5	-12.6	7.2
Memory	-33.6	-6.9	28.2	57.6	20.7	-24.7	11.3
Micro	-11.0	-.3	13.7	16.6	-9.2	13.5	6.4
Logic	9.4	6.5	13.1	.9	.0	-6.2	2.7
Analog	1.3	10.5	-2.4	-12.2	-2.8	.0	-1.6
Total Discrete	-11.1	15.0	-13.0	12.5	-11.1	.0	.0
Total Optoelectronic	-21.4	13.6	12.0	21.4	-20.6	7.4	5.7

Source: Dataquest (May 1991)

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Table 7c
Worldwide Semiconductor Average Selling Prices
(Factory ASP in U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Semiconductor	.41	.44	.47	.48	.49	.64
Total IC	1.40	1.53	1.65	1.62	1.63	2.00
Bipolar Digital	.70	.71	.72	.70	.69	.69
Memory						
Logic						
MOS Digital	2.46	2.79	3.17	3.08	3.18	4.02
Memory	4.86	6.07	7.34	8.10	9.00	17.56
Micro	4.36	4.43	4.49	4.35	4.29	4.34
Logic	1.12	1.24	1.41	1.30	1.32	1.54
Analog	.71	.71	.70	.68	.67	.68
Total Discrete	.08	.08	.08	.08	.08	.08
Total Optoelectronic	.29	.29	.29	.29	.29	.29

Source: Dataquest (May 1991)

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Table 7d
Worldwide Semiconductor Average Selling Prices
(Percent Change in Dollars)

Company: All
Product: Each
Region of Consumption: Worldwide
Distribution Channel: All
Application: All
Specification: All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Semiconductor	3.2	8.7	5.7	2.4	3.3	4.6	5.2
Total IC	5.6	9.2	7.5	-2.0	.8	4.1	4.1
Bipolar Digital	2.9	1.4	1.4	-2.8	-1.4	.3	.0
Memory							
Logic							
MOS Digital	6.0	13.3	13.7	-2.8	3.1	6.5	4.8
Memory	9.7	24.9	20.9	10.4	11.1	15.2	14.3
Micro	1.9	1.6	1.4	-3.1	-1.4	.0	.2
Logic	5.7	10.7	13.7	-7.8	1.5	4.5	3.1
Analog	1.4	.0	-1.4	-2.9	-1.5	-.9	.3
Total Discrete	.0	.0	.0	.0	.0	.0	.0
Total Optoelectronic	.0	.0	.0	.0	.0	.0	.0

Source: Dataquest (May 1991)

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Table 8a
Worldwide Semiconductor Unit Shipments
(Millions of Units)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Semiconductor	80,380	89,881	114,551	122,085	137,808	147,757
Total IC	17,607	21,654	25,260	31,098	32,303	35,553
Bipolar Digital	5,172	6,092	6,899	7,429	6,443	6,529
Memory						
Logic						
MOS Digital	6,171	7,850	9,028	11,336	12,446	13,923
Memory	1,475	1,872	1,960	2,401	2,782	2,955
Micro	875	1,115	1,435	1,721	2,176	2,352
Logic	3,820	4,864	5,633	7,214	7,488	8,616
Analog	6,264	7,712	9,334	12,333	13,414	15,101
Total Discrete	57,200	62,283	83,188	84,578	95,775	102,938
Total Optoelectronic	5,573	5,944	6,104	6,409	9,730	9,266

Source: Dataquest (May 1991)

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Table 8b
Worldwide Semiconductor Unit Shipments
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Semiconductor	.0	11.8	27.4	6.6	12.9	7.2	12.9
Total IC	-14.4	23.0	16.7	23.1	3.9	10.1	15.1
Bipolar Digital	-29.5	17.8	13.2	7.7	-13.3	1.3	4.8
Memory							
Logic							
MOS Digital	-7.1	27.2	15.0	25.6	9.8	11.9	17.7
Memory	-7.6	26.9	4.7	22.5	15.9	6.2	14.9
Micro	-4.5	27.4	28.7	20.0	26.4	8.1	21.9
Logic	-7.4	27.3	15.8	28.1	3.8	15.1	17.7
Analog	-5.0	23.1	21.0	32.1	8.8	12.6	19.2
Total Discrete	3.2	8.9	33.6	1.7	13.2	7.5	12.5
Total Optoelectronic	26.9	6.7	2.7	5.0	51.8	-4.8	10.7

Source: Dataquest (May 1991)

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Table 8c
Worldwide Semiconductor Unit Shipments
(Millions of Units)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Semiconductor	162,794	174,510	192,080	207,313	213,438	291,457
Total IC	38,522	41,864	45,791	51,921	55,118	82,282
Bipolar Digital	6,606	6,575	6,504	6,400	6,168	4,742
Memory						
Logic						
MOS Digital	15,339	16,614	17,557	20,211	21,072	32,399
Memory	3,081	3,097	3,134	3,220	3,143	3,240
Micro	2,779	3,365	3,990	4,615	5,036	10,154
Logic	9,479	10,152	10,433	12,376	12,893	19,005
Analog	16,577	18,675	21,730	25,310	27,878	45,141
Total Discrete	113,900	121,425	134,013	141,775	143,913	188,075
Total Optoelectronic	10,372	11,221	12,276	13,617	14,407	21,100

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Table 8d
Worldwide Semiconductor Unit Shipments
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Semiconductor	10.2	7.2	10.1	7.9	3.0	7.6	6.4
Total IC	8.4	8.7	9.4	13.4	6.2	9.2	8.3
Bipolar Digital	1.2	-.5	-1.1	-1.6	-3.6	-1.1	-5.1
Memory							
Logic							
MOS Digital	10.2	8.3	5.7	15.1	4.3	8.6	9.0
Memory	4.3	.5	1.2	2.7	-2.4	1.2	.6
Micro	18.2	21.1	18.6	15.7	9.1	16.4	15.1
Logic	10.0	7.1	2.8	18.6	4.2	8.4	8.1
Analog	9.8	12.7	16.4	16.5	10.1	13.0	10.1
Total Discrete	10.6	6.6	10.4	5.8	1.5	6.9	5.5
Total Optoelectronic	11.9	8.2	9.4	10.9	5.8	9.2	7.9

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North American OEM Revenue by Application

Source: Dataquest

Semiconductor Applications Markets *Worldwide*

Dataquest

North American OEM Revenue by Application

Source: Dataquest

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Electronic Equipment Company Revenue

INTRODUCTION

This section forms the Semiconductor Application Markets (SAM) service's first major database. The other databases include the electronic equipment production database, the semiconductor consumption (by application market) database, and the (semiconductor) input/(electronic equipment) output—or input/output (I/O)—ratio database. The electronic equipment revenue database has the following three purposes:

- To provide concrete historical information—The section provides a database of the electronic equipment revenue of the 50 largest U.S. electronics manufacturers. We estimate that these 50 companies' electronics revenue accounts for 64 percent of the 200 largest U.S. companies' electronics shipments in 1990 and therefore represents a good base for examining trends in the electronic equipment marketplace. This database is an efficient tool for analyzing growth by application market segment of the activities of individual companies.
- To offer a check on other summary data—The information complements a historical view of semiconductor consumption with an equipment viewpoint rather than simply a product-shipment analysis.
- To serve as a cross-check in the development of I/O ratios—Tracking the actual semiconductor consumption (both merchant and captive) and the actual electronic equipment revenue of given users allows an analysis of the I/O ratio, which is the relationship between semiconductor dollar value and the dollar value of the equipment in which the semiconductors are used.

In addition to electronic system semiconductor consumption analysis, Dataquest has developed and verified I/O ratios by interviewing procurement, contract, and materials managers who are experts in knowing their individual companies' merchant and captive use of semiconductors. We have interviewed more than 200 leading electronics manufacturers that have given us proprietary information on their semiconductor procurement, their captive production, and their relationships to the equipment or divisions in which the devices are used.

Dataquest has agreed to use this information only for internal purposes and report these ratios only on an aggregate basis. The I/O ratios that we develop are applied to the forecasts of electronic equipment production to estimate the associated level of semiconductor consumption. Information in those I/O ratios is available to clients that subscribe to our online services and can also be solicited from our analysts by using the inquiry privilege. The result is a series of forecasts of semiconductor consumption by application market presented in the "Semiconductor Consumption Analysis" section.

OVERVIEW

The information that follows is the result of a comprehensive database that tracks and analyzes the electronic equipment revenue of the 50 largest U.S. electronic equipment manufacturing companies. Major companies' revenue is listed, segmented and presented in this section in various ways. Accordingly, the data, covering an 11-year span (1979 to 1990), are presented as follows:

- Table 1—Data Processing Equipment-Derived Revenue by Company, 1979 to 1990
- Table 2—Communications Equipment-Derived Revenue by Company, 1979 to 1990
- Table 3—Industrial Equipment-Derived Revenue by Company, 1979 to 1990
- Table 4—Consumer Equipment-Derived Revenue by Company, 1979 to 1990
- Table 5—Military/Civil Aerospace Equipment-Derived Revenue by Company, 1979 to 1990
- Table 6—Transportation Equipment-Derived Revenue by Company, 1979 to 1990
- Table 7—Total Electronic Equipment-Derived Revenue by Company, 1979 to 1990
- Table 8—Total Equipment Plus Semiconductor-Derived Revenue by Company, 1979 to 1990
- Table 9—Total Revenue by Company, 1979 to 1990

METHODOLOGY

The following criterion is used to select companies for inclusion in the database: Include the 50 largest U.S. electronic systems manufacturers, based on their respective total electronic-system derived revenue for 1990. These companies are selected from a much larger sample of U.S. companies, the annual "Electronic Business 200" feature of *Electronic Business.*

Company annual reports and 10-K reports provided the main source of information on equipment shipments. (I/O ratios were developed with subsequent detailed analysis.) Virtually every annual report lists a company's revenue by line of business, with each line of business usually being referred to as a segment. Descriptions of each segment's revenue also are reported. Dataquest used these descriptions to determine whether or not a segment's revenue should be added to the database.

Given that the information in some annual reports is limited, Dataquest developed the following protocols to provide continuity to the database:

- The latest annual report was always used. For example, a typical 1990 report might have historical segment data for a three- or five-year period. If only three years were reported, the 1989 report was examined for 1987 information and the data for 1989 and 1988 were simply checked against the information in the 1990 report to ensure that a company had not reclassified its reporting structure. Using the latest annual report provided continuity in the segments and their revenue. Revenue is for the company's fiscal year, not calendar year.
- The large companies' segments included nonelectronic equipment. If electronic equipment made up the majority of the segment or if there was a heavy technical influence in the description, the entire revenue was added to the database. Unless specifically detailed or additional information was obtainable, percentages were not applied to segment revenue based on the proportion or type of electronic equipment in that segment.
- Despite the name a company gave to a given segment, a description of the equipment in a segment was used to determine in which of the six Dataquest application market segments the revenue belonged. Some of the larger companies' segments had such a varied product mix that they crossed over the Dataquest segmentation. In such cases, the major product influence in that segment's description mandated which of our categories the revenue went into.
- In segments where there was little or no clear evidence of electronic equipment, the revenue was not added to the database. Nonelectronic lines of business also were not included.
- Services, interest, supply, rentals, and other additional or product-support revenue were eliminated from the database if they were listed in the report. Most companies in the database separated such revenue. Software revenue also was eliminated when it was broken out as a separate line item or if additional information indicated a percentage.

These gray areas appeared in only a portion of the companies in the database. Because Dataquest dealt with them using the standards just described, we believe that this sample of companies provides a thorough and useful alternative (to more aggregate production data) snapshot of activity in the six application market segments that affect semiconductor consumption. The strength of this database lies in its power to identify and examine broad electronic system production trends with respect to specific companies. As additional years' data accumulate, we can examine the link between electronic equipment production and semiconductor consumption more closely and analyze their historical effects on each other.

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Table 1
Data Processing Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied-Signal	0	0	0	0	0	0	0	0	0	0	0	0
Amdahl	NA	NA	NA	NA	692	550	584	696	1,174	1,444	1,715	1,700
Apple Computer	48	113	325	533	873	1,301	1,668	1,807	2,645	3,940	5,210	5,391
AT&T	0	0	0	0	0	96	592	721	459	890	1,000	1,080
Boeing	0	0	0	0	0	0	0	0	0	0	0	0
Chrysler	0	0	0	0	0	0	0	0	0	0	0	0
Compaq Computer	0	0	0	0	111	329	504	625	1,224	2,066	2,876	3,599
Control Data	1,148	1,473	1,660	1,699	1,916	2,128	2,246	1,880	1,870	1,626	1,216	927
Data General	439	549	589	617	596	884	912	919	850	914	875	785
Digital Equipment	1,382	1,779	2,384	2,794	2,854	3,796	4,266	4,753	5,479	6,269	6,867	6,830
Emerson Electric	0	0	0	0	0	0	0	0	0	0	0	0
E-Systems	0	0	0	0	0	0	0	0	0	0	0	0
Ford Motor	0	0	0	0	0	0	0	0	0	0	0	0
General Dynamics	0	0	0	0	0	0	0	0	0	0	0	0
General Electric	0	0	0	0	0	0	0	0	0	0	0	0
General Instrument[1]	NA	NA	NA	NA	NA	NA	NA	NA	135	221	318	0
GM Hughes	0	0	0	0	0	0	0	0	0	0	0	0
GTE	0	0	0	0	0	0	0	0	0	0	0	0
Harris[2]	366	464	556	622	656	679	394	319	179	139	167	758
Hewlett-Packard	848	1,208	1,386	1,694	1,936	2,234	2,405	2,809	3,199	4,174	5,223	5,675
Honeywell	748	828	895	788	778	936	1,081	940	0	0	0	0
IBM	12,050	14,124	15,808	18,850	22,164	28,341	34,690	32,954	33,909	36,239	36,369	40,258
Intel[3]	251	280	264	275	347	428	345	274	416	525	697	751
ITT	0	0	0	0	0	0	0	0	0	0	0	0
Kodak	533	652	681	767	721	857	788	932	1,048	1,181	1,260	1,242
Litton Industries	0	0	0	0	0	0	0	0	0	0	0	0
Lockheed	0	0	0	0	0	0	0	0	0	0	0	0
Loral	0	0	0	0	0	0	0	0	0	0	0	0
Martin Marrietta	0	0	0	0	0	0	0	0	0	0	0	0
McDonnell Douglas[4]	NA	NA	NA	NA	167	162	175	206	211	189	0	0
Motorola	116	296	371	427	463	558	598	496	427	566	552	599
NCR	1,510	1,683	1,696	1,703	1,710	1,972	2,158	2,410	2,983	3,085	3,122	3,007
Pitney Bowes	0	0	0	0	0	0	1,386	1,506	1,726	1,956	2,119	2,283
Raytheon	0	0	0	0	0	0	0	0	0	0	0	0
Rockwell International	0	0	0	0	0	0	0	0	0	0	0	0
Seagate Technology	0	0	0	0	0	344	215	460	958	1,266	1,372	2,413
Sun Microsystems	0	0	0	0	9	39	115	200	457	894	1,500	2,348
Tandem Computers	NA	NA	NA	NA	400	477	533	622	829	951	1,220	1,370
Tandy	91	165	370	550	771	864	802	953	1,046	1,161	1,179	1,134
Tektronix	240	326	391	441	455	529	567	534	501	238	279	307
Texas Instruments[5]	759	888	958	1,024	962	963	862	789	769	851	900	1,089

(Continued)

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Table 1 (Continued)
Data Processing Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3M	695	772	797	808	854	946	906	929	918	1,130	1,186	1,245
TRW	0	0	0	0	0	0	0	0	0	0	0	0
Unisys[6]	0	0	0	0	0	0	0	1,953	3,670	3,737	3,861	3,718
United Technologies	0	0	0	0	0	0	0	0	0	0	0	0
Varian Associates	0	0	0	0	0	0	0	0	0	0	0	0
Wang Laboratories	188	318	501	677	898	1,271	1,363	1,524	1,593	1,704	1,678	1,456
Westinghouse Electric	0	0	0	0	0	0	0	0	0	0	0	0
Xerox[5]	2,390	3,043	3,410	3,289	3,695	4,282	4,318	4,822	5,702	6,174	6,696	7,099
Zenith Electronics[7]	38	104	120	132	172	249	352	548	1,036	1,356	0	0

[1] Acquired by Forstmann Little & Co. in August 1990.
[2] Data processing revenue restated back through 1985.
[3] Data processing revenue equals net revenue (per annual report) less total semiconductor revenue (per Dataquest market share estimates).
[4] Data processing operations discontinued in 1989.
[5] Data processing revenue restated back through 1987.
[6] Formerly Burroughs, Sperry; merged in 1987. Revenue combined in prior years.
[7] Data processing operations sold to Groupe Bull in December 1989.
NA = Not available
Source: Dataquest (August 1991)

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Table 2
Communications Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied-Signal	0	0	0	0	0	0	0	0	0	0	0	0
Amdahl	0	0	0	0	65	80	81	47	70	89	72	68
Apple Computer	0	0	0	0	0	0	0	0	0	0	0	0
AT&T	5,954	6,467	7,306	7,770	8,429	10,093	10,002	8,676	8,875	9,005	9,042	9,630
Boeing	0	0	0	0	0	0	0	0	0	0	0	0
Chrysler	0	0	0	0	0	0	0	0	0	0	0	0
Compaq Computer	0	0	0	0	0	0	0	0	0	0	0	0
Control Data	0	0	0	0	0	0	0	0	0	0	0	0
Data General	0	0	0	0	0	0	0	0	0	0	0	0
Digital Equipment	0	0	0	0	14	38	86	177	207	225	225	224
Emerson Electric	0	0	0	0	0	0	0	0	0	0	0	0
E-Systems	0	0	0	0	0	0	0	0	0	0	0	0
Ford Motor	0	0	0	0	0	0	0	0	0	0	0	0
General Dynamics	0	0	0	0	0	0	0	0	0	0	0	0
General Electric	104	160	164	220	218	228	239	771	828	1,064	1,091	1,148
General Instrument	NA	NA	NA	NA	NA	NA	NA	NA	764	794	817	0
GM Hughes	0	0	0	0	0	0	0	0	0	0	0	0
GTE	985	1,006	1,066	1,185	1,298	1,178	1,289	1,212	562	663	723	860
Harris[1]	232	245	306	397	391	369	301	291	243	250	350	360
Hewlett-Packard	0	0	0	0	0	0	0	0	0	0	0	0
Honeywell	0	0	0	0	0	0	0	0	0	0	0	0
IBM	0	0	0	0	0	0	600	900	1,100	1,600	3,000	2,950
Intel	0	0	0	0	0	0	0	0	0	0	0	0
ITT	0	0	0	0	0	0	0	0	0	0	0	0
Kodak	0	0	0	0	0	0	0	0	0	0	0	0
Litton Industries	0	0	0	0	0	0	0	0	0	0	0	0
Lockheed	0	0	0	0	0	0	0	0	0	0	0	0
Loral	0	0	0	0	0	0	0	0	0	0	0	0
Martin Marrietta	0	0	0	0	0	0	0	0	0	0	0	0
McDonnell Douglas	0	0	0	0	0	109	125	180	81	36	0	0
Motorola	845	1,156	1,328	1,405	1,490	1,891	2,118	2,637	2,981	3,754	4,587	5,338
NCR	0	0	0	0	0	0	0	0	0	0	0	113
Pitney Bowes	0	0	0	0	0	0	0	0	0	0	0	0
Raytheon	0	0	0	0	0	0	0	0	0	0	0	0
Rockwell International	316	342	363	379	488	579	733	761	860	843	836	851
Seagate Technology	0	0	0	0	0	0	0	0	0	0	0	0
Sun Microsystems	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Computers	0	0	0	0	0	0	0	0	0	140	150	175
Tandy	43	78	110	148	223	264	283	352	401	433	485	513
Tektronix	100	129	150	171	192	221	236	216	255	247	296	01
Texas Instruments	0	0	0	0	0	0	0	0	0	0	0	0

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Table 2 (Continued)
Communications Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3M	0	0	0	0	0	0	0	0	0	0	0	0
TRW	0	0	0	0	0	0	0	0	0	0	0	0
Unisys	0	0	0	0	0	0	0	0	0	0	0	0
United Technologies	0	0	0	0	0	0	0	0	0	0	0	0
Varian Associates	0	0	0	0	0	0	0	0	0	0	0	0
Wang Laboratories	NA	NA	NA	NA	NA	0	0	68	90	96	80	70
Westinghouse Electric	0	0	0	0	0	0	0	0	0	0	0	0
Xerox	0	0	0	0	0	0	0	0	0	0	0	0
Zenith Electronics[2]	0	8	27	64	122	146	53	58	73	0	0	0

[1] Communications revenue restated back through 1985.
[2] Cable products reclassified under consumer starting in 1988.
NA = Not available
Source: Dataquest (August 1991)

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Table 3
Industrial Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied-Signal	379	426	487	576	784	950	893	1,517	0	0	0	0
Amdahl	0	0	0	0	0	0	0	0	0	0	0	0
Apple Computer	0	0	0	0	0	0	0	0	0	0	0	0
AT&T	0	0	0	0	0	0	0	0	0	0	0	0
Boeing	0	0	0	0	0	0	0	0	0	0	0	0
Chrysler	0	0	0	0	0	0	0	0	0	0	0	0
Compaq Computer	0	0	0	0	0	0	0	0	0	0	0	0
Control Data	0	0	0	0	0	0	0	0	0	0	0	0
Data General	0	0	0	0	0	0	0	0	0	0	0	0
Digital Equipment	0	0	0	0	0	0	0	0	0	0	0	0
Emerson Electric	NA	NA	NA	NA	NA	NA	NA	NA	1,410	1,554	1,710	1,937
E-Systems	0	0	0	0	0	0	0	0	0	0	0	0
Ford Motor	0	0	0	0	0	0	0	0	0	0	0	0
General Dynamics	0	0	0	0	0	0	0	0	0	0	0	0
General Electric	714	895	1,127	1,467	1,586	2,303	2,564	3,356	3,854	5,303	5,348	5,433
General Instrument	0	0	0	0	0	0	0	0	0	0	0	0
GM Hughes	0	0	0	0	0	0	821	769	647	929	1,486	1,534
GTE	0	0	0	0	0	0	0	0	0	0	0	0
Harris	0	0	0	0	0	0	0	0	0	0	0	0
Hewlett-Packard	1,301	1,589	1,795	2,072	2,290	2,504	2,529	2,651	2,983	3,479	4,164	4,402
Honeywell	1,986	2,239	2,384	2,444	2,452	2,628	2,736	2,878	3,071	3,436	3,569	3,851
IBM	0	0	0	0	0	0	0	0	0	0	0	0
Intel	0	0	0	0	0	0	0	0	0	0	0	0
ITT[1]	2,111	1,869	1,877	1,754	1,657	1,813	983	748	741	839	960	1,057
Kodak	703	861	899	973	882	885	901	933	1,048	1,181	1,260	1,242
Litton Industries	749	933	988	992	952	1,054	861	940	997	1,280	1,411	1,388
Lockheed	0	0	0	0	0	0	0	0	0	0	0	0
Loral	0	0	0	0	0	0	0	0	0	0	0	0
Martin Marrietta	0	0	0	0	0	0	0	0	0	0	0	0
McDonnell Douglas	0	0	0	0	0	0	0	0	0	0	0	0
Motorola	19	21	22	25	32	39	40	42	44	42	41	41
NCR	0	0	0	0	0	0	0	0	0	0	0	0
Pitney Bowes	0	0	0	0	0	0	0	0	0	0	0	0
Raytheon	0	0	0	0	0	0	0	0	0	0	0	0
Rockwell International[2]	351	369	384	403	424	455	669	1,076	1,080	1,249	1,389	1,447
Seagate Technology	0	0	0	0	0	0	0	0	0	0	0	0
Sun Microsystems	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Computers	0	0	0	0	0	0	0	0	0	0	0	0
Tandy	0	0	0	0	0	0	0	0	0	0	0	0
Tektronix	438	504	508	568	527	564	615	583	618	882	858	800
Texas Instruments	0	0	0	0	0	0	0	0	0	0	0	0

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Table 3 (Continued)
Industrial Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3M	219	265	292	300	305	319	323	353	398	479	501	548
TRW	0	0	0	0	0	0	0	0	0	0	0	0
Unisys	0	0	0	0	0	0	0	0	0	0	0	0
United Technologies	0	0	0	0	0	0	0	0	0	0	0	0
Varian Associates	268	327	358	369	403	544	590	472	531	612	752	787
Wang Laboratories	0	0	0	0	0	0	0	0	0	0	0	0
Westinghouse Electric	0	0	0	0	0	0	0	0	0	0	0	0
Xerox	0	0	0	0	0	0	0	0	0	0	0	0
Zenith Electronics	0	0	0	0	0	0	0	0	0	0	0	0

[1] Industrial revenue restated back through 1987.
[2] Industrial revenue restated back through 1985.
NA = Not available
Source: Dataquest (August 1991)

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Table 4
Consumer Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied-Signal	0	0	0	0	0	0	0	0	0	0	0	0
Amdahl	0	0	0	0	0	0	0	0	0	0	0	0
Apple Computer	0	0	0	0	0	0	0	0	0	0	0	0
AT&T	0	0	0	0	0	0	0	0	0	0	0	0
Boeing	0	0	0	0	0	0	0	0	0	0	0	0
Chrysler	0	0	0	0	0	0	0	0	0	0	0	0
Compaq Computer	0	0	0	0	0	0	0	0	0	0	0	0
Control Data	0	0	0	0	0	0	0	0	0	0	0	0
Data General	0	0	0	0	0	0	0	0	0	0	0	0
Digital Equipment	0	0	0	0	0	0	0	0	0	0	0	0
Emerson Electric	NA	NA	NA	NA	NA	NA	NA	NA	97	100	97	89
E-Systems	0	0	0	0	0	0	0	0	0	0	0	0
Ford Motor	0	0	0	0	0	0	0	0	0	0	0	0
General Dynamics	0	0	0	0	0	0	0	0	0	0	0	0
General Electric	4,347	4,274	4,460	3,973	4,246	4,853	5,549	7,144	7,746	5,289	5,620	5,706
General Instrument	0	0	0	0	0	0	0	0	0	0	0	0
GM Hughes	0	0	0	0	0	0	0	0	0	0	0	0
GTE	0	0	0	0	0	0	0	0	0	0	0	0
Harris	0	0	0	0	0	0	0	0	0	0	0	0
Hewlett-Packard	0	0	0	0	0	0	0	0	0	0	0	0
Honeywell	0	0	0	0	0	0	0	0	0	0	0	0
IBM	0	0	0	0	0	0	0	0	0	0	0	0
Intel	0	0	0	0	0	0	0	0	0	0	0	0
ITT	0	0	0	0	0	0	0	0	0	0	0	0
Kodak	874	1,069	1,117	1,180	1,042	1,023	1,126	1,242	1,398	1,575	1,680	1,656
Litton Industries	175	173	189	166	167	248	240	190	0	0	0	0
Lockheed	0	0	0	0	0	0	0	0	0	0	0	0
Loral	0	0	0	0	0	0	0	0	0	0	0	0
Martin Marrietta	0	0	0	0	0	0	0	0	0	0	0	0
McDonnell Douglas	0	0	0	0	0	0	0	0	0	0	0	0
Motorola	0	5	9	11	13	16	17	18	19	18	18	18
NCR	0	0	0	0	0	0	0	0	0	0	0	0
Pitney Bowes	0	0	0	0	0	0	0	0	0	0	0	0
Raytheon	97	129	128	113	142	159	157	175	181	196	214	208
Rockwell International	0	0	0	0	0	0	0	0	0	0	0	0
Seagate Technology	0	0	0	0	0	0	0	0	0	0	0	0
Sun Microsystems	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Computers	0	0	0	0	0	0	0	0	0	0	0	0
Tandy	859	881	985	896	983	1,067	1,186	1,363	1,540	1,696	1,865	2,160
Tektronix	0	0	0	0	0	0	0	0	0	0	0	0
Texas Instruments	0	0	0	0	0	0	0	0	0	0	0	0

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Table 4 (Continued)
Consumer Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3M	0	0	0	0	0	0	0	0	0	0	0	0
TRW	0	0	0	0	0	0	0	0	0	0	0	0
Unisys	0	0	0	0	0	0	0	0	0	0	0	0
United Technologies	0	0	0	0	0	0	0	0	0	0	0	0
Varian Associates	0	0	0	0	0	0	0	0	0	0	0	0
Wang Laboratories	0	0	0	0	0	0	0	0	0	0	0	0
Westinghouse Electric	0	0	0	0	0	0	0	0	0	0	0	0
Xerox	0	0	0	0	0	0	0	0	0	0	0	0
Zenith Electronics*	1,012	1,003	1,041	939	923	1,062	1,062	1,154	1,026	1,186	1,321	1,229

*Consumer revenue restated back through 1988.
NA = Not available
Source: Dataquest (August 1991)

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Table 5
Military/Civil Aerospace Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied Signal[1]	545	641	734	745	815	850	475	745	820	825	908	938
Amdahl	0	0	0	0	0	0	0	0	0	0	0	0
Apple Computer	0	0	0	0	0	0	0	0	0	0	0	0
AT&T[1]	NA	NA	NA	NA	NA	NA	485	545	570	580	610	630
Boeing[2]	0	0	0	0	0	0	705	853	990	1,050	1,040	1,415
Chrysler	0	0	0	0	0	0	0	0	0	0	0	0
Compaq Computer	0	0	0	0	0	0	0	0	0	0	0	0
Control Data	0	0	0	0	0	0	0	0	0	0	0	0
Data General	0	0	0	0	0	0	0	0	0	0	0	0
Digital Equipment	0	0	0	0	0	0	0	0	0	0	0	0
Emerson Electric[2]	NA	NA	NA	NA	NA	NA	555	561	545	552	540	578
E-Systems[1]	323	362	489	623	705	733	926	1,135	1,227	1,301	1,470	1,636
Ford Motor[3]	NA	NA	NA	NA	NA	NA	1,100	1,165	1,200	1,180	1,210	0
General Dynamics	NA	NA	NA	NA	NA	NA	1,120	1,210	1,175	1,182	1,165	1,180
General Electric[1]	714	1,549	1,878	2,079	2,237	2,509	3,215	3,818	4,209	4,273	4,215	4,435
General Instrument	0	0	0	0	0	0	0	0	0	0	0	0
GM Hughes[1]	0	0	0	0	0	0	5,128	5,635	5,847	6,060	5,664	5,846
GTE[2]	585	597	634	707	736	719	787	1,050	1,100	1,145	1,080	1,139
Harris[1]	218	263	307	399	529	630	1,025	1,030	1,100	1,080	1,155	1,135
Hewlett-Packard[2]	0	0	0	0	0	0	0	0	0	0	0	0
Honeywell[2]	499	598	662	755	878	918	1,119	1,219	1,899	1,840	2,004	2,071
IBM[1]	525	555	617	737	1,110	1,412	1,501	1,821	2,130	1,977	1,921	2,114
Intel	0	0	0	0	0	0	0	0	0	0	0	0
ITT[1]	768	703	797	992	1,020	1,213	1,122	1,279	1,280	839	960	1,612
Kodak	0	0	0	0	0	0	0	0	0	0	0	0
Litton Industries[1]	587	741	977	996	1,338	1,588	1,916	2,172	2,231	2,291	2,143	2,200
Lockheed[1]	1,321	1,802	2,196	2,673	2,776	3,735	2,243	2,519	3,169	3,184	3,054	3,075
Loral	NA	NA	NA	NA	NA	NA	472	625	638	1,072	1,121	1,872
Martin Marrietta[1]	1,049	1,062	1,474	1,668	1,775	2,156	1,571	1,745	1,869	2,078	2,238	2,255
McDonnell Douglas[1]	400	459	559	556	618	736	330	378	435	480	495	552
Motorola[2]	176	227	236	245	369	441	496	526	540	648	698	685
NCR	0	0	0	0	0	0	0	0	0	0	0	0
Pitney Bowes	0	0	0	0	0	0	0	0	0	0	0	0
Raytheon[1]	1,500	1,649	1,946	2,160	2,614	2,959	2,844	3,253	3,569	3,760	4,015	4,154
Rockwell International[1]	1,112	1,243	1,267	1,331	1,458	1,678	2,035	2,384	2,370	2,135	2,197	2,173
Seagate Technology	0	0	0	0	0	0	0	0	0	0	0	0
Sun Microsystems	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Computers	0	0	0	0	0	0	0	0	0	0	0	0
Tandy	0	0	0	0	0	0	0	0	0	0	0	0
Tektronix	0	0	0	0	0	0	0	0	0	0	0	0
Texas Instruments[1]	545	738	876	1,059	1,204	1,392	1,480	1,717	1,967	2,142	2,148	2,111

(Continued)

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Table 5 (Continued)
Military/Civil Aerospace Equipment-Derived Revenue
by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3M	0	0	0	0	0	0	0	0	0	0	0	0
TRW[1]	854	1,003	1,202	1,253	1,479	1,551	2,370	2,434	2,906	2,985	2,990	3,108
Unisys[1]	0	0	0	0	0	0	0	2,765	2,354	2,365	2,255	2,214
United Technologies	NA	NA	NA	NA	NA	NA	NA	979	1,072	1,124	1,220	1,339
Varian Associates	0	0	0	0	0	0	0	0	0	0	0	0
Wang Laboratories	0	0	0	0	0	0	0	0	0	0	0	0
Westinghouse Electric[1]	652	810	912	1,524	1,561	1,640	1,605	1,720	1,807	1,936	1,982	2,149
Xerox	0	0	0	0	0	0	0	0	0	0	0	0
Zenith Electronics	0	0	0	0	0	0	0	0	0	0	0	0

[1] Restated back through 1985 per Dataquest's MilAero Service.
[2] As per Dataquest's MilAero Service.
[3] As per Dataquest's MilAero Service. Ford Aerospace sold to Loral in October 1990.
NA = Not available
Source: Dataquest (August 1991)

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Table 6
Transportation Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied-Signal	199	200	218	225	237	263	205	287	355	410	385	418
Amdahl	0	0	0	0	0	0	0	0	0	0	0	0
Apple Computer	0	0	0	0	0	0	0	0	0	0	0	0
AT&T	0	0	0	0	0	0	0	0	0	0	0	0
Boeing	0	0	0	0	0	0	0	0	0	0	0	0
Chrysler	0	0	0	0	0	0	0	0	0	1,454	1,292	1,255
Compaq Computer	0	0	0	0	0	0	0	0	0	0	0	0
Control Data	0	0	0	0	0	0	0	0	0	0	0	0
Data General	0	0	0	0	0	0	0	0	0	0	0	0
Digital Equipment	0	0	0	0	0	0	0	0	0	0	0	0
Emerson Electric	0	0	0	0	0	0	0	0	0	0	0	0
E-Systems	0	0	0	0	0	0	0	0	0	0	0	0
Ford Motor	0	0	0	0	0	0	734	951	1,200	1,308	1,360	1,382
General Dynamics	0	0	0	0	0	0	0	0	0	0	0	0
General Electric	0	0	0	0	0	0	0	0	0	0	0	0
General Instrument	0	0	0	0	0	0	0	0	0	0	0	0
GM Hughes	0	0	0	0	0	0	3,061	3,180	3,216	3,800	4,000	4,128
GTE	0	0	0	0	0	0	0	0	0	0	0	0
Harris	0	0	0	0	0	0	0	0	0	0	0	0
Hewlett-Packard	0	0	0	0	0	0	0	0	0	0	0	0
Honeywell	0	0	0	0	0	0	0	0	0	0	0	0
IBM	0	0	0	0	0	0	0	0	0	0	0	0
Intel	0	0	0	0	0	0	0	0	0	0	0	0
ITT*	768	735	735	730	786	923	784	1,014	1,176	1,239	1,323	1,458
Kodak	0	0	0	0	0	0	0	0	0	0	0	0
Litton Industries	0	0	0	0	0	0	0	0	0	0	0	0
Lockheed	0	0	0	0	0	0	0	0	0	0	0	0
Loral	0	0	0	0	0	0	0	0	0	0	0	0
Martin Marrietta	0	0	0	0	0	0	0	0	0	0	0	0
McDonnell Douglas	0	0	0	0	0	0	0	0	0	0	0	0
Motorola	159	201	203	223	250	294	288	302	314	301	292	292
NCR	0	0	0	0	0	0	0	0	0	0	0	0
Pitney Bowes	0	0	0	0	0	0	0	0	0	0	0	0
Raytheon	0	0	0	0	0	0	0	0	0	0	0	0
Rockwell International	0	0	0	0	0	0	0	0	0	0	0	0
Seagate Technology	0	0	0	0	0	0	0	0	0	0	0	0
Sun Microsystems	0	0	0	0	0	0	0	0	0	0	0	0
Tandem Computers	0	0	0	0	0	0	0	0	0	0	0	0
Tandy	0	0	0	0	0	0	0	0	0	0	0	0
Tektronix	0	0	0	0	0	0	0	0	0	0	0	0
Texas Instruments	0	0	0	0	0	0	0	0	0	0	0	0

(Continued)

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Table 6 (Continued)
Transportation Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3M	0	0	0	0	0	0	0	0	0	0	0	0
TRW	944	920	888	806	937	935	977	1,077	1,224	1,995	2,233	2,651
Unisys	0	0	0	0	0	0	0	0	0	0	0	0
United Technologies	0	0	0	0	0	0	0	0	0	0	0	0
Varian Associates	0	0	0	0	0	0	0	0	0	0	0	0
Wang Laboratories	0	0	0	0	0	0	0	0	0	0	0	0
Westinghouse Electric	0	0	0	0	0	0	0	0	0	0	0	0
Xerox	0	0	0	0	0	0	0	0	0	0	0	0
Zenith Electronics	0	0	0	0	0	0	0	0	0	0	0	0

*Restated back through 1988 per 1990 annual report.
Source: Dataquest (August 1991)

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Table 7
Total Electronic Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied-Signal	1,123	1,267	1,439	1,546	1,836	2,063	1,573	2,549	1,175	1,235	1,293	1,356
Amdahl	0	0	0	0	757	630	665	743	1,244	1,533	1,787	1,768
Apple Computer	48	113	325	533	873	1,301	1,668	1,807	2,645	3,940	5,210	5,391
AT&T	5,954	6,467	7,306	7,770	8,429	10,189	11,079	9,942	9,904	10,475	10,652	11,340
Boeing	0	0	0	0	0	0	705	853	990	1,050	1,040	1,415
Chrysler	0	0	0	0	0	0	0	0	0	1,454	1,292	1,255
Compaq Computer	0	0	0	0	111	329	504	625	1,224	2,066	2,876	3,599
Control Data	1,148	1,473	1,660	1,699	1,916	2,128	2,246	1,880	1,870	1,626	1,216	927
Data General	439	549	589	617	596	884	912	919	850	914	875	785
Digital Equipment	1,382	1,779	2,384	2,794	2,868	3,834	4,352	4,930	5,686	6,494	7,092	7,054
Emerson Electric	0	0	0	0	0	0	555	561	2,052	2,206	2,347	2,604
E-Systems	323	362	489	623	705	733	926	1,135	1,227	1,301	1,470	1,636
Ford Motor	0	0	0	0	0	0	1,834	2,116	2,400	2,488	2,570	1,382
General Dynamics	0	0	0	0	0	0	1,120	1,210	1,175	1,182	1,165	1,180
General Electric	5,879	6,878	7,629	7,739	8,287	9,893	11,567	15,089	16,637	15,929	16,274	16,722
General Instrument	0	0	0	0	0	0	0	0	899	1,015	1,135	0
GM Hughes	0	0	0	0	0	0	9,010	9,584	9,710	10,789	11,150	11,508
GTE	1,570	1,603	1,700	1,892	2,034	1,897	2,076	2,262	1,662	1,808	1,803	1,999
Harris	816	972	1,169	1,418	1,576	1,678	1,720	1,640	1,522	1,469	1,672	2,253
Hewlett-Packard	2,149	2,797	3,181	3,766	4,226	4,738	4,934	5,460	6,182	7,653	9,387	10,077
Honeywell	3,233	3,665	3,941	3,987	4,108	4,482	4,936	5,037	4,970	5,276	5,573	5,922
IBM	12,575	14,679	16,425	19,587	23,274	29,753	36,791	35,675	37,139	39,816	41,290	45,322
Intel	251	280	264	275	347	428	345	274	416	525	697	751
ITT	3,647	3,307	3,409	3,476	3,463	3,949	2,889	3,041	3,197	2,917	3,243	4,127
Kodak	2,110	2,582	2,697	2,920	2,645	2,765	2,815	3,107	3,494	3,937	4,200	4,140
Litton Industries	1,511	1,847	2,154	2,154	2,457	2,890	3,017	3,302	3,228	3,571	3,554	3,588
Lockheed	1,321	1,802	2,196	2,673	2,776	3,735	2,243	2,519	3,169	3,184	3,054	3,075
Loral	0	0	0	0	0	0	472	625	638	1,072	1,121	1,872
Martin Marietta	1,049	1,062	1,474	1,668	1,775	2,156	1,571	1,745	1,869	2,078	2,238	2,255
McDonnell Douglas	400	459	559	556	785	1,007	630	764	727	705	495	552
Motorola	1,315	1,906	2,169	2,336	2,617	3,239	3,557	4,021	4,325	5,329	6,188	6,973
NCR	1,510	1,683	1,696	1,703	1,710	1,972	2,158	2,410	2,983	3,085	3,122	3,120
Pitney Bowes	0	0	0	0	0	0	1,386	1,506	1,726	1,956	2,119	2,283
Raytheon	1,597	1,778	2,074	2,273	2,756	3,118	3,001	3,428	3,750	3,956	4,229	4,362
Rockwell International	1,779	1,954	2,014	2,113	2,370	2,712	3,437	4,221	4,310	4,227	4,422	4,471
Seagate Technology	0	0	0	0	0	344	215	460	958	1,266	1,372	2,413
Sun Microsystems	0	0	0	0	9	39	115	200	457	894	1,500	2,348
Tandem Computers	0	0	0	0	400	477	533	622	829	1,091	1,370	1,545
Tandy	993	1,124	1,465	1,594	1,977	2,195	2,271	2,668	2,987	3,290	3,529	3,807
Tektronix	778	959	1,049	1,180	1,174	1,314	1,418	1,333	1,374	1,367	1,433	1,408

(Continued)

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Table 7 (Continued)
Total Electronic Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Sun Microsystems	0	0	0	0	9	39	115	200	457	894	1,500	2,348
Tandem Computers	0	0	0	0	400	477	533	622	829	1,091	1,370	1,545
Tandy	993	1,124	1,465	1,594	1,977	2,195	2,271	2,668	2,987	3,290	3,529	3,807
Tektronix	778	959	1,049	1,180	1,174	1,314	1,418	1,333	1,374	1,367	1,433	1,408
Texas Instruments	1,304	1,626	1,834	2,083	2,166	2,355	2,342	2,506	2,736	2,993	3,048	3,200
3M	914	1,037	1,089	1,108	1,159	1,265	1,229	1,282	1,316	1,609	1,687	1,793
TRW	1,798	1,923	2,090	2,059	2,416	2,486	3,347	3,511	4,130	4,980	5,223	5,759
Unisys	0	0	0	0	0	0	0	4,718	6,024	6,102	6,116	5,932
United Technologies	0	0	0	0	0	0	0	979	1,072	1,124	1,220	1,339
Varian Associates	268	327	358	369	403	544	590	472	531	612	752	787
Wang Laboratories	188	318	501	677	898	1,271	1,363	1,592	1,683	1,800	1,758	1,526
Westinghouse Electric	652	810	912	1,524	1,561	1,640	1,605	1,720	1,807	1,936	1,982	2,149
Xerox	2,390	3,043	3,410	3,289	3,695	4,282	4,318	4,822	5,702	6,174	6,696	7,099
Zenith Electronics	1,050	1,115	1,188	1,135	1,217	1,457	1,467	1,760	2,135	2,542	1,321	1,229

Source: Dataquest (August 1991)

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Table 8
Total Equipment Plus Semiconductor-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied-Signal	1,123	1,267	1,439	1,546	1,836	2,063	1,573	2,549	1,175	1,235	1,293	1,356
Amdahl	0	0	0	0	757	630	665	743	1,244	1,533	1,787	1,768
Apple Computer	48	113	325	533	873	1,301	1,668	1,807	2,645	3,940	5,210	5,391
AT&T	5,954	6,467	7,306	7,770	8,429	10,189	11,079	10,835	10,706	11,334	11,525	12,201
Boeing	0	0	0	0	0	0	705	853	990	1,050	1,040	1,415
Chrysler	0	0	0	0	0	0	0	0	0	1,454	1,292	1,255
Compaq Computer	0	0	0	0	111	329	504	625	1,224	2,066	2,876	3,599
Control Data	1,148	1,473	1,660	1,699	1,916	2,128	2,246	1,880	1,870	1,626	1,216	927
Data General	439	549	589	617	596	884	912	919	850	914	875	785
Digital Equipment	1,382	1,779	2,384	2,794	2,868	3,834	4,352	4,930	5,686	6,494	7,092	7,054
Emerson Electric	0	0	0	0	0	0	555	561	2,052	2,206	2,347	2,604
E-Systems	323	362	489	623	705	733	926	1,135	1,227	1,301	1,470	1,636
Ford Motor	0	0	0	0	0	0	1,834	2,116	2,400	2,488	2,570	1,382
General Dynamics	0	0	0	0	0	0	1,120	1,210	1,175	1,182	1,165	1,180
General Electric	5,879	6,878	7,750	7,841	8,402	10,029	11,685	15,610	17,157	16,484	16,274	16,722
General Instrument	0	0	0	0	0	0	0	0	899	1,015	1,135	0
GM Hughes	0	0	21	20	25	32	9,046	9,623	9,753	10,836	11,187	11,552
GTE	1,570	1,603	1,726	1,924	2,053	1,921	2,103	2,284	1,686	1,808	1,803	1,999
Harris	816	972	1,334	1,574	1,747	1,934	1,967	1,907	1,797	1,798	2,214	3,053
Hewlett-Packard	2,149	2,797	3,273	3,868	4,356	4,920	5,140	5,678	6,425	7,923	9,656	10,586
Honeywell	3,233	3,665	3,959	4,007	4,132	4,546	5,024	5,174	5,157	5,458	5,629	5,971
IBM	12,575	14,679	16,425	19,587	23,274	29,753	36,791	35,675	37,139	39,816	41,290	45,322
Intel	661	855	789	900	1,122	1,629	1,365	1,265	1,907	2,875	3,127	3,922
ITT	3,647	3,307	3,584	3,666	3,648	4,199	3,159	3,353	3,554	3,277	3,633	4,498
Kodak	2,110	2,582	2,697	2,920	2,645	2,765	2,815	3,107	3,494	3,937	4,200	4,140
Litton Industries	1,511	1,847	2,154	2,154	2,457	2,890	3,017	3,302	3,228	3,571	3,554	3,588
Lockheed	1,321	1,802	2,196	2,673	2,776	3,735	2,243	2,519	3,169	3,184	3,054	3,075
Loral	0	0	0	0	0	0	472	625	638	1,072	1,121	1,872
Martin Marrietta	1,049	1,062	1,474	1,668	1,775	2,156	1,571	1,745	1,869	2,078	2,238	2,255
McDonnell Douglas	400	459	559	556	785	1,007	630	764	727	705	495	552
Motorola	1,315	1,906	3,359	3,555	4,264	5,558	5,387	6,046	6,759	8,364	9,507	10,667
NCR	1,510	1,683	1,696	1,731	1,785	2,052	2,233	2,504	3,099	3,217	3,242	3,265
Pitney Bowes	0	0	0	0	0	0	1,386	1,506	1,726	1,956	2,119	2,283
Raytheon	1,597	1,778	2,125	2,325	2,821	3,213	3,080	3,512	3,839	4,055	4,325	4,446
Rockwell International	1,779	1,954	2,084	2,193	2,427	2,769	3,481	4,345	4,482	4,401	4,587	4,671
Seagate Technology	0	0	0	0	0	344	215	460	958	1,266	1,372	2,413
Sun Microsystems	0	0	0	0	9	39	115	200	457	894	1,500	2,348
Tandem Computers	0	0	0	0	400	477	533	622	829	1,091	1,370	1,545
Tandy	993	1,124	1,465	1,594	1,977	2,195	2,271	2,668	2,987	3,290	3,529	3,807
Tektronix	778	959	1,049	1,180	1,174	1,314	1,418	1,333	1,374	1,367	1,433	1,408
Texas Instruments	1,304	1,626	3,129	3,388	3,804	4,839	4,084	4,287	4,863	5,734	5,835	5,774

(Continued)

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Table 8 (Continued)
Total Electronic Equipment-Derived Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3M	914	1,037	1,089	1,108	1,159	1,265	1,229	1,282	1,316	1,609	1,687	1,793
TRW	1,798	1,923	2,204	2,175	2,534	2,633	3,472	3,616	4,247	5,041	5,250	5,787
Unisys	0	0	0	0	0	0	0	4,718	6,024	6,102	6,116	5,932
United Technologies	0	0	0	0	0	0	0	979	1,072	1,124	1,220	1,339
Varian Associates	268	327	358	369	403	544	590	472	531	612	752	787
Wang Laboratories	188	318	501	677	898	1,271	1,363	1,592	1,683	1,800	1,758	1,526
Westinghouse Electric	652	810	971	1,577	1,619	1,692	1,657	1,720	1,807	1,936	1,982	2,149
Xerox	2,390	3,043	3,410	3,289	3,695	4,282	4,318	4,822	5,702	6,174	6,696	7,099
Zenith Electronics	1,050	1,115	1,188	1,135	1,217	1,457	1,467	1,760	2,135	2,542	1,321	1,229

Source: Dataquest (August 1991)

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Table 9
Total Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Allied-Signal	7,480	9,164	10,511	9,414	8,159	8,864	8,183	9,888	11,116	11,909	11,942	12,343
Amdahl	NA	NA	NA	NA	NA	NA	862	966	1,505	1,802	2,101	2,159
Apple Computer	48	117	335	583	983	1,516	1,918	1,902	2,661	4,071	5,284	5,558
AT&T[1]	19,208	20,861	23,567	25,064	27,190	33,187	34,496	34,213	33,768	35,210	36,112	37,285
Boeing	NA	NA	NA	NA	NA	NA	13,745	16,444	15,505	16,962	20,276	27,595
Chrysler[2]	NA	NA	NA	NA	NA	NA	21,256	22,586	26,277	35,473	34,922	30,620
Compaq Computer	0	0	0	0	111	329	504	625	1,224	2,066	2,876	3,599
Control Data	2,249	2,772	3,120	3,301	3,408	3,693	3,680	3,347	3,367	3,628	2,935	1,691
Data General	507	654	737	806	829	1,161	1,239	1,268	1,274	1,365	1,314	1,216
Digital Equipment	1,804	2,368	3,198	3,881	4,272	5,584	6,686	7,590	9,389	11,475	12,742	12,943
Emerson Electric	NA	3,410	3,846	3,807	3,810	4,587	4,921	5,242	6,170	6,652	7,071	7,573
E-Systems	394	442	572	754	827	819	949	1,135	1,227	1,439	1,626	1,810
Ford Motor	NA	NA	NA	NA	NA	56,323	57,616	69,695	79,893	92,446	96,146	97,650
General Dynamics	3,314	4,100	4,524	5,937	6,841	7,328	7,993	8,959	9,412	9,551	10,043	10,173
General Electric	22,461	24,959	27,240	26,500	26,797	27,947	29,240	36,728	40,515	40,292	42,650	44,879
General Instrument[3]	NA	NA	NA	NA	NA	NA	612	788	1,155	1,305	1,377	0
GM Hughes[4]	0	0	0	0	0	0	9,504	10,440	10,481	11,244	11,359	11,723
GTE	8,499	9,486	10,506	11,500	12,237	13,248	14,372	15,112	15,421	16,460	17,424	18,374
Harris[5]	NA	976	1,121	1,301	1,467	1,671	1,967	1,907	1,797	1,798	2,214	3,053
Hewlett-Packard	2,361	3,099	3,528	4,189	4,710	6,044	6,505	7,102	8,090	9,831	11,899	13,233
Honeywell[6]	4,270	4,870	5,261	5,387	4,241	3,888	4,209	4,475	5,590	5,857	6,059	6,309
IBM[1]	22,863	26,213	29,070	34,364	40,180	45,937	50,718	52,160	55,256	59,681	62,710	69,018
Intel	661	855	789	900	1,122	1,629	1,365	1,265	1,907	2,875	3,127	3,922
ITT[7]	21,996	23,819	23,197	21,921	20,249	19,553	13,781	16,214	18,131	19,306	20,005	20,604
Kodak	8,028	9,734	10,337	10,815	10,170	10,600	10,631	11,550	13,305	17,304	18,398	18,908
Litton Industries	3,066	3,294	3,978	4,124	3,959	4,606	4,591	4,521	4,420	4,864	5,023	5,156
Lockheed[1]	3,532	4,445	5,176	5,613	6,154	7,881	9,223	9,942	11,078	10,433	9,891	9,958
Loral	201	238	282	310	418	502	664	676	1,136	1,187	1,274	2,127
Martin Marrietta[1]	1,908	1,930	2,680	3,033	3,228	3,920	4,421	4,763	5,173	5,727	5,796	6,126
McDonnell Douglas	5,332	6,125	7,454	7,412	8,424	9,819	11,618	12,772	13,289	14,438	14,589	16,255
Motorola	2,700	3,284	3,570	3,786	4,328	5,534	5,456	5,905	6,727	8,250	9,620	10,885
NCR	3,003	3,322	3,433	3,526	3,731	4,074	4,317	4,882	5,641	5,990	5,956	6,285
Pitney Bowes	NA	NA	NA	NA	NA	NA	1,787	1,989	2,270	2,576	2,876	3,196
Raytheon	4,177	4,775	5,384	5,217	5,631	5,996	6,409	7,308	7,659	8,192	8,796	9,268
Rockwell International	6,176	6,907	7,040	7,395	8,098	9,322	11,338	12,296	12,123	11,946	12,518	12,379
Seagate Technology	NA	NA	NA	NA	NA	344	215	460	958	1,266	1,372	2,413
Sun Microsystems	0	0	0	0	9	39	115	210	538	1,052	1,765	2,466
Tandem Computers	NA	NA	NA	NA	NA	NA	636	778	1,048	1,315	1,633	1,866
Tandy	1,216	1,387	1,699	1,832	2,241	2,490	2,596	3,036	3,452	3,794	4,181	4,500
Tektronix	787	971	1,062	1,196	1,191	1,333	1,438	1,352	1,396	1,412	1,433	1,408
Texas Instruments[1]	3,224	4,075	4,206	4,327	4,580	5,742	4,930	4,988	5,816	6,447	6,522	6,567

(Continued)

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Table 9 (Continued)
Total Revenue by Company, 1979 to 1990
(Millions of Dollars)

Company	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
3M[6]	5,440	6,080	6,508	6,601	7,039	7,947	8,117	9,056	10,004	11,323	11,990	13,021
TRW	3,967	4,336	4,597	4,452	4,840	5,369	5,917	6,036	6,821	6,982	7,340	8,169
Unisys[8]	0	0	0	0	0	0	0	7,431	9,732	9,935	10,097	10,111
United Technologies	NA	NA	NA	NA	NA	NA	NA	15,669	17,170	18,000	19,532	21,442
Varian Associates[9]	400	510	598	656	691	854	883	798	873	1,045	1,220	1,265
Wang Laboratories[7]	321	543	856	1,158	1,535	2,174	2,331	2,615	2,751	2,952	2,910	2,497
Westinghouse Electric[1]	7,443	8,514	9,368	9,745	9,533	10,265	11,269	11,370	11,332	12,500	12,844	12,915
Xerox[10]	6,715	7,786	8,316	8,073	10,274	11,242	11,899	13,187	14,890	16,177	17,229	17,973
Zenith Electronics	1,186	1,186	1,275	1,239	1,361	1,716	1,624	1,892	2,363	2,686	1,549	1,410

[1] Total revenue restated back through 1985 per 1989 annual report.
[2] Total revenue restated back through 1987 per 1990 annual report.
[3] Acquired by Forstmann Little & Co. in August 1990.
[4] Total revenue restated back through 1987 per 1989 annual report.
[5] Total revenue restated back through 1980.
[6] Total revenue restated back through 1984 per 1989 annual report.
[7] Total revenue restated back through 1986.
[8] Total revenue restated back through 1986 per 1989 annual report.
[9] Total revenue restated back through 1983.
[10] Total revenue restated back through 1985 per 1990 annual report.
NA = Not available
Source: Dataquest (August 1991)

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Market Statistics:
Data Processing Equipment Worldwide

Source:
Dataquest

Semiconductor Application Markets *Worldwide*

Dataquest

Market Statistics:
Data Processing Equipment Worldwide

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Market Statistics: Data Processing Equipment—Worldwide

Introduction

This document contains information on Dataquest's view of selected worldwide data processing equipment markets.

The tables are organized as follows:

Table 1	Worldwide Computer Systems Forecast—Factory Revenue
Table 2	Worldwide Computer Systems Forecast—Unit Shipments
Table 3	Worldwide Computer Systems Forecast—Average Selling Price
Table 4	Worldwide PC Forecast by Bus Type—Unit Shipments
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Table 22	Worldwide Printer Forecast
Table 23	Worldwide Printer Market Share—Estimated Unit Shipments

Table 1
Worldwide Computer Systems Forecast—Factory Revenue
(Millions of Dollars)

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Supercomputer	1,536.1	1,757.0	1,940.0	2,250.0	2,465.0	2,780.0	3,100.0	12.4
Mainframe	29,559.2	30,304.5	29,350.0	30,100.0	29,700.0	29,300.0	28,700.0	-0.6
Midrange	27,951.7	29,927.3	30,600.0	31,500.0	32,500.0	33,600.0	34,700.0	3.2
Workstation	6,126.1	7,357.0	9,200.0	12,200.0	15,700.0	19,500.0	23,200.0	26.0
PC Subtotal	41,735.0	49,863.0	54,993.0	61,142.0	67,175.0	75,083.0	83,690.0	11.1
Transportable	546.0	413.0	725.0	399.0	224.0	139.0	94.0	-40.0
Laptop AC	1,899.0	1,758.0	2,084.0	1,324.0	553.0	306.0	182.0	-45.6
Laptop DC	3,040.0	5,637.0	6,936.0	7,818.0	8,463.0	8,740.0	8,872.0	6.3
Notebook	86.0	927.0	1,373.0	2,845.0	5,306.0	9,330.0	13,169.0	76.0
Pen-Based	2.0	15.0	183.0	777.0	3,812.0	8,733.0	13,131.0	191.0
Hand-Held	21.0	55.0	226.0	644.0	1,226.0	2,135.0	3,443.0	97.6
Desktop	35,528.0	38,015.0	37,546.0	38,283.0	36,711.0	33,860.0	32,610.0	-3.5
Deskside	613.0	3,043.0	5,920.0	9,052.0	10,880.0	11,840.0	12,189.0	19.8
Total	106,908.1	119,208.8	126,083.0	137,192.0	147,540.0	160,263.0	173,390.0	8.3

Source: Dataquest (August 1991)

Table 2
Worldwide Computer Systems Forecast—Unit Shipments

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Supercomputer	826	815	939	1,113	1,267	1,472	1,680	15.7
Mainframe	14,324	15,117	14,700	14,700	14,210	14,100	13,900	-1.4
Midrange	905,149	1,025,235	1,066,900	1,112,300	1,160,800	1,210,400	1,264,000	4.3
Workstation	292,167	386,157	550,000	836,000	1,191,000	1,647,400	2,200,000	41.4
PC Subtotal	21,846,000	23,994,000	26,296,000	29,278,000	33,699,000	39,493,000	46,604,000	15.4
Transportable	133,000	101,000	173,000	94,000	53,000	33,000	23,000	-39.6
Laptop AC	416,000	349,000	311,000	199,000	88,000	50,000	33,000	-42.9
Laptop DC	1,883,000	2,587,000	3,172,000	3,592,000	3,998,000	4,370,000	4,744,000	10.6
Notebook	32,000	408,000	686,000	1,441,000	2,760,000	4,934,000	7,180,000	79.9
Pen-Based	1,000	10,000	96,000	353,000	1,590,000	3,498,000	5,422,000	174.1
Hand-Held	82,000	217,000	503,000	1,559,000	3,087,000	5,588,000	9,365,000	107.7
Desktop	19,036,000	19,735,000	20,254,000	20,377,000	20,144,000	18,824,000	17,531,000	-3.5
Deskside	263,000	587,000	1,101,000	1,663,000	1,979,000	2,196,000	2,306,000	20.3
Total	23,058,466	25,421,324	27,928,539	31,242,113	36,066,277	42,366,372	50,083,580	15.7

Source: Dataquest (August 1991)

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Table 3
Worldwide Computer Systems Forecast—Average Selling Price
(Thousands of Dollars)

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Supercomputer	1,860.0	2,156.0	2,066.0	2,022.0	1,946.0	1,889.0	1,845.0	-2.8
Mainframe	2,064.0	2,005.0	1,997.0	2,048.0	2,090.0	2,078.0	2,065.0	0.8
Midrange	31.0	29.0	29.0	28.0	28.0	28.0	28.0	-1.1
Workstation	21.0	19.0	17.0	15.0	13.0	12.0	11.0	-11.0
PCs								
Transportable	4.1	4.1	4.2	4.3	4.2	4.2	4.1	-0.3
Laptop AC	4.6	5.0	6.7	6.7	6.3	6.1	5.5	-5.0
Laptop DC	1.6	2.2	2.2	2.2	2.1	2.0	1.9	-3.9
Notebook	2.7	2.3	2.0	2.0	1.9	1.9	1.8	-2.2
Pen-Based	1.5	1.5	1.9	2.2	2.4	2.5	2.4	6.2
Hand-Held	0.3	0.3	0.5	0.4	0.4	0.4	0.4	-4.8
Desktop	1.9	1.9	1.9	1.9	1.8	1.8	1.9	0.1
Deskside	2.3	5.2	5.4	5.4	5.5	5.4	5.3	-0.4

Source: Dataquest (August 1991)

Table 4
Worldwide PC Forecast by Bus Type
(Thousands of Unit Shipments)

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
PC XT	3,638	2,549	1,625	273	0	0	0	-100.0
AT	10,570	11,332	11,893	12,996	11,386	8,037	4,586	-21.2
MCA (16 Bit)	1,221	1,450	1,328	1,211	945	760	463	-23.2
MCA (32 Bit)	603	889	1,835	2,696	3,827	5,033	6,441	36.9
EISA	4	272	770	1,140	1,903	2,741	3,480	45.8
Others	5,809	7,511	8,846	10,961	15,637	22,924	31,634	37.5
Total	21,845	24,003	26,297	29,277	33,698	39,495	46,604	15.4

Source: Dataquest (August 1991)

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Table 5
Worldwide PC Forecast by Microprocessor Type—Unit Shipments

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
8088/8086	4,539	3,998	3,180	1,555	1,266	1,844	1,967	-11.3
80286	7,950	7,433	5,473	3,466	3,051	4,107	7,093	6.7
80386SX	1,897	4,589	6,763	8,009	6,666	5,704	3,721	-13.9
80386SL	0	0	463	2,124	3,856	6,142	7,605	101.3
80386DX	2,551	3,552	4,890	5,974	5,009	4,198	5,612	3.5
80486SX	0	0	300	2,447	6,372	8,721	10,758	144.7
80486DX	5	328	922	1,638	2,856	3,299	3,382	38.4
80586	0	0	0	5	223	613	1,141	NM
68XXX	2,068	2,861	3,295	3,623	4,227	4,759	5,266	12.4
Others	2,835	1,232	1,010	438	174	107	59	-50.8
Total	21,845	23,993	26,296	29,279	33,700	39,494	46,604	15.4

NM = Not meaningful
Source: Source: Dataquest (August 1991)

Table 6
Estimated PC and Workstation DRAM Configurations—Weighted Average
(Megabytes per System)

	1990	1995
PCs		
8088/8086	1.0	4.0
80286	1.3	8.0
80386SX	2.0	12.0
80386SL		12.0
80386DX	2.0	12.0
80486SX		27.5
80486DX	4.0	31.6
80586		48.0
68XXX	1.8	12.0
Others	0.8	4.0
Workstations	12.0	134.0

Source: Dataquest (August 1991)

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Table 7
Worldwide Non-PC Computer System Market Share
Estimated Unit Shipments

	Market Share (%)	
	1989	1990
Supercomputer Vendors		
Convex Computer	20.7	25.4
Alliant Computer	15.9	12.3
Intel	9.7	9.8
AMT	8.5	9.2
Cray Research	8.9	7.8
FPS Computing	8.4	6.4
Digital Equipment	0.0	5.2
IBM	3.4	4.3
MasPar Computer	0.0	3.7
Thinking Machines	1.9	2.7
Others	22.7	13.4
Total	100.0	100.0
Mainframe Vendors		
IBM	26.5	30.1
Hitachi	12.0	14.7
Fujitsu	15.9	13.1
NEC	12.8	13.1
Unisys	9.7	6.6
Siemens Nixdorf	0.0	4.7
ICL	4.7	4.6
Groupe Bull	0.0	4.0
Mitsubishi	2.7	2.5
The Ultimate Group	1.6	1.6
Others	14.1	5.2
Total	100.0	100.0

(Continued)

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Table 7 (Continued)
Worldwide Non-PC Computer System Market Share
Estimated Unit Shipments

	Market Share (%)	
	1989	1990
Midrange Vendors		
Unisys	20.7	23.1
IBM	13.7	12.0
NEC	8.5	7.1
Fujitsu	6.4	6.9
AT&T	4.9	6.3
Digital Equipment	5.4	4.8
Groupe Bull	0.0	4.1
NCR	4.2	3.1
Hitachi	2.5	2.4
Siemens Nixdorf	0	2.4
Others	33.8	27.8
Total	100.0	100.0
Workstation Vendors		
Sun Microsystems	32.9	37.5
Digital Equipment	20.6	17.6
Hewlett-Packard	18.5	16.7
Intergraph	5.5	5.2
IBM	2.6	4.2
Sony	3.6	3.1
Silicon Graphics	2.3	2.6
Xerox	2.3	2.1
NEC	1.1	1.4
Omron	1.0	1.1
Others	9.7	8.5
Total	100.0	100.0

Source: Dataquest (August 1991)

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Table 8
Worldwide PC Unit Market Share
Estimated Unit Shipments

	Market Share (%)	
	1989	1990
All PC Vendors		
IBM	11.8	12.4
Apple	7.4	7.5
Commodore	7.1	7.1
NEC	5.4	5.6
Compaq	3.1	3.9
Toshiba	2.8	3.7
Atari	4.2	3.1
Tandy	2.7	2.6
Epson	2.6	2.5
Packard Bell	2.1	2.4
Olivetti	2.5	1.9
ZDS-Groupe Bull	NA	1.8
Amstrad	2.6	1.3
Hewlett-Packard	1.2	1.2
Samsung	0.2	1.2
Hyundai	0.6	1.1
Tandon	1.1	0.9
Philips	0.8	0.8
MiTAC	0.6	0.8
Acer	0.9	0.7
Others	40.8	38.1
Total	100.0	100.0
Desktop PC Vendors		
IBM	16.2	17.8
Apple	11.0	11.7
Commodore	12.1	11.3
NEC	6.7	6.6
Compaq	3.5	4.5
Tandy	3.8	3.6
Packard Bell	3.0	3.6
Atari	5.8	3.6
Epson	3.6	3.0
Olivetti	3.7	2.9
Others	30.9	31.3
Total	100.0	100.0

(Continued)

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Table 8 (Continued)
Worldwide PC Unit Market Share
Estimated Unit Shipments

	Market Share (%)	
	1989	**1990**
Laptop DC/Pen-Based Computer Vendors		
Toshiba	31.3	36.1
NEC	18.5	17.8
ZDS-Groupe Bull	16.2	9.4
Epson	3.5	5.7
Tandy	2.6	5.1
Compaq	8.5	3.8
Apple	1.4	2.4
GRiD	5.9	2.3
Packard Bell	1.5	2.0
Samsung	0	1.4
Others	10.6	14.1
Total	100.0	100.0
Notebook/Hand-Held Computer Vendors		
Atari	76.1	33.9
Compaq	23.9	32.5
Sharp	0	11.8
Toshiba	0	7.0
Epson	0	5.8
Texas Instruments	0	2.8
Samsung	0	1.3
CompuAdd	0	0.9
NEC	0	0.9
Mitsubishi	0	0.7
Others	0	2.5
Total	100.0	100.0

NA = Not available
Source: Dataquest (August 1991)

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Table 9
Worldwide Rigid Disk Drive Forecast by Width

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Thousands of Units								
2.5 Inch	25	714	2,888	6,192	9,960	12,968	12,836	45.2
3.5 Inch	11,267	21,742	23,727	29,262	31,516	35,304	34,955	10.2
5.25 Inch	7,768	6,877	6,750	4,684	3,734	4,384	6,396	-1.3
8-10 Inch	404	377	417	318	282	127	85	-32.8
14 Inch	263	237	167	134	95	44	33	-33.3
Total	19,727	29,947	33,948	40,591	45,587	52,828	54,305	12.5
Average Selling Price (Dollars)								
2.5 Inch	280	263	247	244	280	284	231	-1.6
3.5 Inch	279	258	260	275	297	338	339	6.9
5.25 Inch	473	474	535	777	926	866	915	14.3
8-10 Inch	5,448	7,580	9,485	9,705	9,455	8,230	6,794	-8.0
14 Inch	18,092	21,934	24,523	23,643	23,184	20,892	19,697	-5.3
Factory Revenue (Millions of Dollars)								
2.5 Inch	7	187	714	1,513	2,786	3,678	2,970	42.8
3.5 Inch	3,139	5,612	6,162	8,047	9,373	11,915	11,864	17.8
5.25 Inch	3,670	3,262	3,613	3,641	3,457	3,798	5,851	12.8
8-10 Inch	2,201	2,855	3,951	3,085	2,664	1,045	577	-38.2
14 Inch	4,762	5,207	4,098	3,178	2,198	928	650	-36.9
Total	13,779	17,123	18,537	19,464	20,478	21,363	21,913	4.3

Source: Source: Dataquest (August 1991)

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Table 10
Worldwide Rigid Disk Drive Forecast by Capacity
(Thousands of Units)

	1990	1995	CAGR (%) 1990-1995
2.5 Inch			
0-30MB	613.6	96.0	-31.0
31-60MB	100.0	960.0	57.2
61-100MB	0	2,800.0	NM
101-200MB	0	2,000.0	NM
201-500MB	0	6,500.0	NM
501-1,000MB	0	480.0	NM
Total	713.6	12,836.0	78.2
3.5 Inch			
0-30MB	4,452.0	1.0	-81.4
31-60MB	12,850.0	4.0	-80.1
61-100MB	1,980.0	60.0	-50.3
101-200MB	1,758.0	11,000.0	44.3
201-500MB	702.0	12,000.0	76.4
501-1,000MB	0	5,700.0	NM
1-2GB	0	6,000.0	NM
2+GB	0	190.0	NM
Total	21,742.0	34,955.0	10.0
5.25 Inch			
0-30MB	1,250.0	0	-100.0
31-60MB	2,030.0	0	-100.0
61-100MB	1,122.0	36.0	-49.7
101-200MB	820.0	100.0	-34.3
201-500MB	955.0	120.0	-34.0
501-1000MB	636.0	640.0	0.1
1-2GB	64.4	3,600.0	123.6
2+GB	0	1,900.0	NM
Total	6,877.4	6,396.0	-1.4

NM = Not meaningful
Source: Dataquest (August 1991)

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Table 11
Worldwide Rigid Disk Drive Market Share—1990
Estimated Unit Shipments

Vendor	Market Share (%)
2.5 Inch	
Conner	58.9
Prairie Tek	18.0
JVC	16.8
Others	6.3
Total	100.0
3.5 Inch	
Conner	20.7
Seagate	15.7
Quantum	11.5
IBM	10.9
Western Digital	10.5
NEC	8.3
Maxtor	6.2
Others	16.3
Total	100.0
5.25 Inch	
Seagate	56.6
Micropolis	7.0
Maxtor	5.4
NEC	3.5
Syquest	2.5
IBM	2.5
Microscience	1.9
Hewlett-Packard	1.7
Others	19.0
Total	100.0

Source: Dataquest (August 1991)

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Table 12
Worldwide Optical Disk Drive Forecast
(Thousands of Units)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
All Versions							
Units	359	584	980	1,667	2,776	4,587	67.4
CD-ROM							
Units	240	360	576	979	1,763	3,173	72.3
ASP ($)	207	145	102	80	68	61	-19.5
Factory Revenue ($M)	50	52	59	78	119	194	39.0
5.25-Inch WORM							
Units	31	44	62	87	122	158	37.7
ASP ($)	1,200	960	768	614	492	418	-18.8
Factory Revenue ($M)	37	42	48	53	60	66	12.0
5.25-Inch Rewritable							
Units	77	154	277	444	620	866	54.0
ASP ($)	2,000	1,600	1,280	1,024	819	655	-20.0
Factory Revenue ($M)	154	246	355	455	508	567	23.2

Source: Dataquest (August 1991)

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Table 13
Worldwide Optical Disk Drive Market Share—1990
Estimated Unit Shipments

Vendor	Market Share (%)
CD-ROM	
Sony	46
Hitachi	18
LMSI	15
Toshiba	9
Pioneer	5
NEC	4
Others	3
Total	100
5.25-Inch WORM	
Ricoh	55
Panasonic	17
Pioneer	12
ISi	6
Others	8
Total	100
5.25-Inch Rewritable	
Sony	49
Ricoh	26
Canon	9
Maxoptix	9
Others	7
Total	100

Source: Dataquest (August 1991)

Table 14
Worldwide Flexible Disk Drive Forecast

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Units (Millions)	30.2	35.9	39.1	42.6	46.1	49.3	52.2	7.5
ASP ($)	56	47	46	45	47.3	49.4	48.6	1.5
Factory Revenue ($M)	1,699	1,671	1,791	1,905	2,177.1	2,432.8	2,540.3	9.1

Source: Dataquest (August 1991)

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Table 15
Worldwide Flexible Disk Drive Market Share—1990
Estimated Unit Shipments

Company	Market Share (%)
Teac	25.7
Chinon	17.6
Panasonic	17.4
Sony	13.6
Mitsubishi	6.1
Y-E Data	6.9
Mitsumi	4.1
Citizen	2.7
Others	6.0
Total	100.0

Source: Dataquest (August 1991)

Table 16
Worldwide Tape Drive Forecast

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Units (Thousands)	1,545	1,611	1,934	2,206	2,495	2,758	2,955	11.2
ASP ($)	1,367	1,236	1,136	1,034	909.3	803.2	750.1	-9.9
Factory Revenue ($M)	2,112	1,991	2,197	2,281	2,268.3	2,214.8	2,216.6	0.2

Source: Dataquest (August 1991)

Table 17
Worldwide Tape Drive Market Share—1990
Estimated Unit Shipments

Company	Market Share (%)
Archive/Irwin	30.6
Wangtek	15.7
Colorado Memory	13.0
Tandberg	8.7
Mountain	6.5
Exabyte	6.2
Digital Equipment	3.8
IBM	1.9
StorageTek	1.8
Hewlett-Packard	1.6
Others	10.2
Total	100.0

Source: Dataquest (August 1991)

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Table 18
Worldwide Display Terminal and Monitor Forecast
(Thousands of Units)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Display Terminals	6,363	6,525	6,663	6,870	7,124	7,403	3.2
Monitors	24,764	27,423	23,544	23,626	26,186	31,163	3.2

Source: Dataquest (August 1991)

Table 19
Worldwide Display Terminal and Monitor Market Share—1990
Estimated Unit Shipments

Company	Market Share (%)
Display Terminal	
IBM	22.6
Wyse	11.3
DEC	8.0
Memorex Telex	5.3
Siemens	3.0
Others	49.8
Total	100.0
Monitor	
IBM	11.3
NEC	6.7
Commodore	5.7
Olivetti	2.9
Epson	2.6
Compaq	2.6
Amstrad	2.5
Atari	2.2
Packard Bell	2.1
Tandy	2.1
Others	59.3
Total	100.0

Source: Dataquest (August 1991)

Table 20
Worldwide X Window Terminal Forecast

	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Units (Thousands)	69	156	301	506	673	861	53.4
ASP ($)	2,608	2,288	1,945	1,653	1,405	1,194	-15.0
Factory Revenue ($M)	180	356	584	836	945	1,028	30.3

Source: Dataquest (August 1991)

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Table 21
Worldwide X Window Terminal Market Share—1990
Estimated Unit Shipments

Company	Market Share (%)
NCD	33.3
DEC	16.5
HP	10.3
IBM	7.6
GraphOn	7.4
Tektronix	5.5
Visual Technology	3.6
HDS	2.6
Sun River	2.2
JCC	2.2
Others	8.8
Total	100.0

Source: Dataquest (August 1991)

Table 22
Worldwide Printer Forecast (Preliminary)
(Thousands of Units)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
All Versions	19,395	20,911	22,041	23,086	24,212	25,271	4.8
Serial	15,233	15,685	15,552	15,419	15,422	15,430	-0.4
Line	197	216	234	247	255	261	4.8
Page	3,965	5,010	6,255	7,420	8,535	9,580	17.6

Source: Dataquest (August 1991)

Table 23
Worldwide Page Printer Market Share—1990
Unit Shipments

Company	Market Share (%)
Hewlett-Packard	49.9
Apple	7.4
IBM	7.1
Canon	5.4
Others	30.2
Total	100.0

Note: This table includes both North American and European markets.
Source: Dataquest (August 1991)

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Worldwide and North American Semiconductor Consumption by Application Markets

Source: Dataquest

Semiconductor Application Markets *Worldwide*

Dataquest

Worldwide and North American Semiconductor Consumption by Application Markets

Source: Dataquest

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Worldwide and North American Semiconductor Consumption by Application Market Forecast

Introduction and Definitions

The tables in this booklet present data to answer the following questions:

- What general electronic equipment areas are driving semiconductor demand?
- What is the semiconductor value composition of various categories of electronic equipment?
- For particular semiconductor categories such as MOS Memory, what is the usage across the various equipment types?

The key term that should be defined is the input/output (I/O) ratio. In the context in which it is used, it describes the percentage of semiconductor content (based on value) per dollar of electronic equipment.

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Table 1a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Each
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Data Processing										
Computers	13,418	16,323	16,151	18,037	21,064	23,525	25,328	27,088	11.7	10.9
Data Storage	3,995	4,229	4,362	4,820	5,080	5,494	6,040	6,470	10.5	8.2
Terminals	2,337	2,506	2,083	2,410	2,814	3,197	3,547	3,763	15.7	12.6
Input/Output	2,133	2,687	2,671	3,302	4,105	5,099	6,201	7,137	23.6	21.7
Dedicated	1,621	1,772	1,723	1,986	2,335	2,712	3,010	3,187	15.3	13.1
Total	23,504	27,517	26,991	30,555	35,397	40,027	44,126	47,645	13.2	12.0
Communications										
Premise Telecom	3,508	4,028	4,212	4,967	6,113	7,595	8,554	8,928	17.9	16.2
Public Telecom	1,550	1,702	1,695	1,977	2,388	2,949	3,230	3,320	16.6	14.4
Mobile Communications	1,058	1,116	1,138	1,330	1,563	1,921	2,167	2,235	16.9	14.5
Broadcast & Studio	188	206	203	239	285	337	368	379	17.7	13.3
Other Communications	545	587	601	701	846	1,056	1,083	1,077	16.6	12.4
Total	6,849	7,638	7,848	9,213	11,195	13,857	15,402	15,938	17.4	15.2
Industrial										
Security & Energy Management	251	256	272	331	408	517	571	597	21.7	17.0
Manufacturing Systems/Instruments	2,880	3,161	3,429	4,160	4,909	6,004	6,537	6,587	21.3	13.9
Medical Equipment	762	815	852	1,008	1,193	1,473	1,669	1,736	18.3	15.3
Other Industrial	935	1,023	1,097	1,330	1,501	1,824	2,036	2,100	21.2	13.9
Total	4,828	5,255	5,649	6,829	8,010	9,818	10,813	11,020	20.9	14.3
Consumer										
Audio	1,503	1,565	1,722	1,956	2,229	2,614	2,894	3,087	13.6	12.4
Video	4,151	4,481	4,653	5,165	5,918	6,810	7,516	7,914	11.0	11.2
Personal Electronics	1,112	1,222	1,375	1,614	1,900	2,257	2,516	2,743	17.4	14.8
Appliances	3,112	3,425	3,616	4,220	5,026	5,997	6,665	7,164	16.7	14.7
Other Consumer	642	683	732	829	976	1,168	1,322	1,438	13.3	14.5
Total	10,520	11,375	12,098	13,785	16,049	18,846	20,913	22,344	13.9	13.1
Military/Aerospace	2,769	2,859	2,846	2,863	3,077	3,291	3,515	3,768	0.6	5.8
Transportation	2,389	2,570	2,794	2,979	3,460	3,963	4,456	4,817	6.6	11.5
Total Equipment	50,859	57,213	58,225	66,223	77,189	89,803	99,225	105,531	13.7	12.6

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 1b
Semiconductor Consumption Forecast
(Percentage of Total Equipment)

Company:	All
Product:	Each
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	26.4	28.5	27.7	27.2	27.3	26.2	25.5	25.7
Data Storage	7.9	7.4	7.5	7.3	6.6	6.1	6.1	6.1
Terminals	4.6	4.4	3.6	3.6	3.6	3.6	3.6	3.6
Input/Output	4.2	4.7	4.6	5.0	5.3	5.7	6.2	6.8
Dedicated	3.2	3.1	3.0	3.0	3.0	3.0	3.0	3.0
Total	46.2	48.1	46.4	46.1	45.9	44.6	44.5	45.1
Communications								
Premise Telecom	6.9	7.0	7.2	7.5	7.9	8.5	8.6	8.5
Public Telecom	3.0	3.0	2.9	3.0	3.1	3.3	3.3	3.1
Mobile Communications	2.1	2.0	2.0	2.0	2.0	2.1	2.2	2.1
Broadcast & Studio	.4	.4	.3	.4	.4	.4	.4	.4
Other Communications	1.1	1.0	1.0	1.1	1.1	1.2	1.1	1.0
Total	13.5	13.4	13.5	13.9	14.5	15.4	15.5	15.1
Industrial								
Security & Energy Management	.5	.4	.5	.5	.5	.6	.6	.6
Manufacturing Systems/Instruments	5.7	5.5	5.9	6.3	6.4	6.7	6.6	6.2
Medical Equipment	1.5	1.4	1.5	1.5	1.5	1.6	1.7	1.6
Other Industrial	1.8	1.8	1.9	2.0	1.9	2.0	2.1	2.0
Total	9.5	9.2	9.7	10.3	10.4	10.9	10.9	10.4
Consumer								
Audio	3.0	2.7	3.0	3.0	2.9	2.9	2.9	2.9
Video	8.2	7.8	8.0	7.8	7.7	7.6	7.6	7.5
Personal Electronics	2.2	2.1	2.4	2.4	2.5	2.5	2.5	2.6
Appliances	6.1	6.0	6.2	6.4	6.5	6.7	6.7	6.8
Other Consumer	1.3	1.2	1.3	1.3	1.3	1.3	1.3	1.4
Total	20.7	19.9	20.8	20.8	20.8	21.0	21.1	21.2
Military/Aerospace	5.4	5.0	4.9	4.3	4.0	3.7	3.5	3.6
Transportation	4.7	4.5	4.8	4.5	4.5	4.4	4.5	4.6
Total Equipment	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (August 1991)

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Table 1c
Semiconductor Consumption Forecast
(Percentage of Application Market)

Company:	All
Product:	Each
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	57.1	59.3	59.8	59.0	59.5	58.8	57.4	56.9
Data Storage	17.0	15.4	16.2	15.8	14.4	13.7	13.7	13.6
Terminals	9.9	9.1	7.7	7.9	7.9	8.0	8.0	7.9
Input/Output	9.1	9.8	9.9	10.8	11.6	12.7	14.1	15.0
Dedicated	6.9	6.4	6.4	6.5	6.6	6.8	6.8	6.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Communications								
Premise Telecom	51.2	52.7	53.7	53.9	54.6	54.8	55.5	56.0
Public Telecom	22.6	22.3	21.6	21.5	21.3	21.3	21.0	20.8
Mobile Communications	15.4	14.6	14.5	14.4	14.0	13.9	14.1	14.0
Broadcast & Studio	2.7	2.7	2.6	2.6	2.5	2.4	2.4	2.4
Other Communications	8.0	7.7	7.7	7.6	7.6	7.6	7.0	6.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Industrial								
Security & Energy Management	5.2	4.9	4.8	4.8	5.1	5.3	5.3	5.4
Manufacturing Systems/Instruments	59.7	60.2	60.7	60.9	61.3	61.2	60.5	59.8
Medical Equipment	15.8	15.5	15.1	14.8	14.9	15.0	15.4	15.8
Other Industrial	19.4	19.5	19.4	19.5	18.7	18.6	18.8	19.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Consumer								
Audio	14.3	13.8	14.2	14.2	13.9	13.9	13.8	13.8
Video	39.5	39.4	38.5	37.5	36.9	36.1	35.9	35.4
Personal Electronics	10.6	10.7	11.4	11.7	11.8	12.0	12.0	12.3
Appliances	29.6	30.1	29.9	30.6	31.3	31.8	31.9	32.1
Other Consumer	6.1	6.0	6.1	6.0	6.1	6.2	6.3	6.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Military/Aerospace	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Transportation	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (August 1991)

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Table 2a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Each
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
North America										
Data Processing	8,574	10,185	9,561	10,405	11,864	13,706	14,866	15,496	8.8	10.1
Communications	1,608	1,805	1,822	2,006	2,352	2,861	3,062	3,060	10.1	10.9
Industrial	1,682	1,741	1,807	2,036	2,380	2,919	3,189	3,227	12.6	12.3
Consumer	1,026	1,199	1,202	1,346	1,535	1,811	2,008	2,198	12.0	12.8
Military/Aerospace	1,999	2,059	2,038	2,016	2,161	2,297	2,440	2,607	-1.1	5.1
Transportation	955	948	956	952	1,094	1,216	1,330	1,413	-0.4	8.1
Total	15,844	17,937	17,836	18,761	21,386	24,810	26,895	28,001	5.2	9.4
Japan										
Data Processing	9,902	11,364	10,987	12,398	14,222	14,702	16,006	17,625	12.8	9.9
Communications	3,016	3,324	2,948	3,699	4,751	6,092	6,998	7,552	25.5	20.7
Industrial	1,426	1,635	1,696	2,401	2,904	3,697	4,100	4,022	41.6	18.9
Consumer	5,599	5,791	5,968	6,933	7,831	9,054	9,870	10,242	16.2	11.4
Military/Aerospace	36	44	49	51	63	71	80	79	4.1	10.0
Transportation	793	839	860	872	991	1,040	1,146	1,241	1.4	7.6
Total	20,772	22,997	22,508	26,354	30,762	34,656	38,200	40,761	17.1	12.6
Europe										
Data Processing	2,540	3,045	3,033	3,663	4,489	5,512	6,226	6,938	20.8	18.0
Communications	1,736	1,967	2,418	2,760	3,186	3,774	4,058	3,944	14.1	10.3
Industrial	1,626	1,732	1,963	2,184	2,482	2,902	3,173	3,363	11.3	11.4
Consumer	1,526	1,844	1,928	2,199	2,602	3,199	3,714	4,205	14.1	16.9
Military/Aerospace	632	647	639	661	706	748	798	850	3.4	5.9
Transportation	431	520	680	807	951	1,178	1,357	1,464	18.7	16.6
Total	8,491	9,755	10,661	12,274	14,416	17,313	19,326	20,764	15.1	14.3
Asia/Pacific-ROW										
Data Processing	2,488	2,923	3,410	4,089	4,822	6,107	7,028	7,586	19.9	17.3
Communications	489	542	660	748	906	1,130	1,284	1,382	13.3	15.9
Industrial	95	147	183	208	244	300	351	408	13.7	17.4
Consumer	2,368	2,539	3,000	3,306	4,082	4,784	5,321	5,697	10.2	13.7
Military/Aerospace	102	109	120	135	147	175	197	232	12.5	14.1
Transportation	210	263	297	348	424	529	623	699	17.2	18.7
Total	5,752	6,524	7,670	8,834	10,625	13,025	14,804	16,004	15.2	15.8
Worldwide										
Data Processing	23,504	27,517	26,991	30,555	35,397	40,027	44,126	47,645	13.2	12.0

(Continued)

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Table 2a (Continued)
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Each
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Communications	6,849	7,638	7,848	9,213	11,195	13,857	15,402	15,938	17.4	15.2
Industrial	4,828	5,255	5,649	6,829	8,010	9,818	10,813	11,020	20.9	14.3
Consumer	10,520	11,375	12,098	13,785	16,049	18,846	20,913	22,344	13.9	13.1
Military/Aerospace	2,769	2,859	2,846	2,863	3,077	3,291	3,515	3,768	.6	5.8
Transportation	2,389	2,570	2,794	2,979	3,460	3,963	4,456	4,817	6.6	11.5
Total	50,859	57,213	58,225	66,223	77,189	89,803	99,225	105,531	13.7	12.6

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 2b
Semiconductor Consumption Forecast
(Percentage of Worldwide Total)

Company:	All
Product:	Each
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
North America								
Data Processing	36.5	37.0	35.4	34.1	33.5	34.2	33.7	32.5
Communications	23.5	23.6	23.2	21.8	21.0	20.6	19.9	19.2
Industrial	34.8	33.1	32.0	29.8	29.7	29.7	29.5	29.3
Consumer	9.8	10.5	9.9	9.8	9.6	9.6	9.6	9.8
Military/Aerospace	72.2	72.0	71.6	70.4	70.2	69.8	69.4	69.2
Transportation	40.0	36.9	34.2	32.0	31.6	30.7	29.9	29.3
Total	31.2	31.4	30.6	28.3	27.7	27.6	27.1	26.5
Japan								
Data Processing	42.1	41.3	40.7	40.6	40.2	36.7	36.3	37.0
Communications	44.0	43.5	37.6	40.1	42.4	44.0	45.4	47.4
Industrial	29.5	31.1	30.0	35.2	36.3	37.7	37.9	36.5
Consumer	53.2	50.9	49.3	50.3	48.8	48.0	47.2	45.8
Military/Aerospace	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.1
Transportation	33.2	32.6	30.8	29.3	28.6	26.2	25.7	25.8
Total	40.8	40.2	38.7	39.8	39.9	38.6	38.5	38.6
Europe								
Data Processing	10.8	11.1	11.2	12.0	12.7	13.8	14.1	14.6
Communications	25.3	25.8	30.8	30.0	28.5	27.2	26.3	24.7
Industrial	33.7	33.0	34.7	32.0	31.0	29.6	29.3	30.5
Consumer	14.5	16.2	15.9	16.0	16.2	17.0	17.8	18.8
Military/Aerospace	22.8	22.6	22.5	23.1	22.9	22.7	22.7	22.6
Transportation	18.0	20.2	24.3	27.1	27.5	29.7	30.5	30.4
Total	16.7	17.1	18.3	18.5	18.7	19.3	19.5	19.7
Asia/Pacific-ROW								
Data Processing	10.6	10.6	12.6	13.4	13.6	15.3	15.9	15.9
Communications	7.1	7.1	8.4	8.1	8.1	8.2	8.3	8.7
Industrial	2.0	2.8	3.2	3.0	3.0	3.1	3.2	3.7
Consumer	22.5	22.3	24.8	24.0	25.4	25.4	25.4	25.5
Military/Aerospace	3.7	3.8	4.2	4.7	4.8	5.3	5.6	6.2
Transportation	8.8	10.2	10.6	11.7	12.3	13.3	14.0	14.5
Total	11.3	11.4	13.2	13.3	13.8	14.5	14.9	15.2
Worldwide								
Data Processing	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Communications	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Industrial	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(Continued)

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Table 2b (Continued)
Semiconductor Consumption Forecast
(Percentage of Worldwide Total)

Company:	All
Product:	Each
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Consumer	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Military/Aerospace	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Transportation	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total	100.0	100.0	100.8	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (August 1991)

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Table 2c
Semiconductor Consumption Forecast
(Percentage of Regional Total)

Company:	All
Product:	Each
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
North America								
Data Processing	54.1	56.8	53.6	55.5	55.5	55.2	55.3	55.3
Communications	10.1	10.1	10.2	10.7	11.0	11.5	11.4	10.9
Industrial	10.6	9.7	10.1	10.8	11.1	11.8	11.9	11.5
Consumer	6.5	6.7	6.7	7.2	7.2	7.3	7.5	7.9
Military/Aerospace	12.6	11.5	11.4	10.7	10.1	9.3	9.1	9.3
Transportation	6.0	5.3	5.4	5.1	5.1	4.9	4.9	5.0
Total	100.0	100.0	97.5	100.0	100.0	100.0	100.0	100.0
Japan								
Data Processing	47.7	49.4	48.8	47.0	46.2	42.4	41.9	43.2
Communications	14.5	14.5	13.1	14.0	15.4	17.6	18.3	18.5
Industrial	6.9	7.1	7.5	9.1	9.4	10.7	10.7	9.9
Consumer	27.0	25.2	26.5	26.3	25.5	26.1	25.8	25.1
Military/Aerospace	.2	.2	.2	.2	.2	.2	.2	.2
Transportation	3.8	3.6	3.8	3.3	3.2	3.0	3.0	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Europe								
Data Processing	29.9	31.2	28.4	29.8	31.1	31.8	32.2	33.4
Communications	20.4	20.2	22.7	22.5	22.1	21.8	21.0	19.0
Industrial	19.1	17.8	18.4	17.8	17.2	16.8	16.4	16.2
Consumer	18.0	18.9	18.1	17.9	18.0	18.5	19.2	20.3
Military/Aerospace	7.4	6.6	6.0	5.4	4.9	4.3	4.1	4.1
Transporatation	5.1	5.3	6.4	6.6	6.6	6.8	7.0	7.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Asia/Pacific-ROW								
Data Processing	43.3	44.8	44.5	46.3	45.4	46.9	47.5	47.4
Communications	8.5	8.3	8.6	8.5	8.5	8.7	8.7	8.6
Industrial	1.7	2.3	2.4	2.4	2.3	2.3	2.4	2.5
Consumer	41.2	38.9	39.1	37.4	38.4	36.7	35.9	35.6
Military/Aerospace	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.4
Transportation	3.7	4.0	3.9	3.9	4.0	4.1	4.2	4.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Worldwide								
Data Processing	46.2	48.1	46.4	46.1	45.9	44.6	44.5	45.1
Communications	13.5	13.4	13.5	13.9	14.5	15.4	15.5	15.1
Industrial	9.5	9.2	9.7	10.3	10.4	10.9	10.9	10.4

(Continued)

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Table 2c (Continued)
Semiconductor Consumption Forecast
(Percentage of Regional Total)

Company:	All
Product:	Each
Region of Production:	Each
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Consumer	20.7	19.9	20.8	20.8	20.8	21.0	21.1	21.2
Military/Aerospace	5.4	5.0	4.9	4.3	4.0	3.7	3.5	3.6
Transportation	4.7	4.5	4.8	4.5	4.5	4.4	4.5	4.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (August 1991)

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Table 3a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Each
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Data Processing										
Computers	6,292	7,591	7,016	7,539	8,562	9,777	10,457	10,631	7.5	8.7
Data Storage	923	951	948	965	910	924	906	959	1.8	0.2
Terminals	212	227	198	239	296	350	377	391	20.6	14.6
Input/Output	809	1,060	1,074	1,319	1,692	2,177	2,599	2,962	22.8	22.5
Dedicated	337	357	326	343	406	478	527	553	5.3	11.1
Total	8,574	10,185	9,561	10,405	11,864	13,706	14,866	15,496	8.8	10.1
Communications										
Premise Telecom	867	1,019	1,060	1,172	1,383	1,673	1,830	1,847	10.6	11.8
Public Telecom	335	357	342	370	425	503	528	512	8.2	8.4
Mobile Communications	119	131	130	147	174	211	232	236	12.8	12.6
Broadcast & Studio	77	79	74	79	89	103	106	100	5.9	6.2
Other Communications	211	220	216	239	281	371	366	365	10.7	11.1
Total	1,608	1,805	1,822	2,006	2,352	2,861	3,062	3,060	10.1	10.9
Industrial										
Security & Energy Management	137	137	145	161	189	234	253	257	11.2	12.2
Manufacturing Systems	664	676	690	780	916	1,136	1,247	1,264	13.0	12.9
Instrumentation	352	372	386	433	506	615	672	681	12.3	12.1
Medical Equipment	280	290	299	333	384	465	502	504	11.4	11.0
Other Industrial	250	267	288	329	386	470	515	521	14.2	12.6
Total	1,682	1,741	1,807	2,036	2,380	2,919	3,189	3,227	12.6	12.3
Consumer										
Audio	42	43	46	51	57	66	72	78	11.4	11.3
Video	215	268	271	298	331	382	415	447	9.9	10.6
Personal Electronics	23	27	29	32	36	42	46	50	11.5	11.6
Appliances	659	761	761	859	988	1,174	1,311	1,443	12.9	13.7
Other Consumer	87	99	96	106	123	147	165	181	11.1	13.6
Total	1,026	1,199	1,202	1,346	1,535	1,811	2,008	2,198	12.0	12.8
Military/Aerospace	1,999	2,059	2,038	2,016	2,161	2,297	2,440	2,607	-1.1	5.1
Transportation	955	948	956	952	1,094	1,216	1,330	1,413	-0.4	8.1
Total Equipment	15,844	17,937	17,836	18,761	21,386	24,810	26,895	28,001	5.2	9.4

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 3b
Semiconductor Consumption Forecast
(Percentage of Total Equipment)

Company:	All
Product:	Each
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	39.7	42.3	39.3	40.2	40.0	39.4	38.9	38.0
Data Storage	5.8	5.3	5.3	5.1	4.3	3.7	3.4	3.4
Terminals	1.3	1.3	1.1	1.3	1.4	1.4	1.4	1.4
Input/Output	5.1	5.9	6.0	7.0	7.9	8.8	9.7	10.6
Dedicated	2.1	2.0	1.8	1.8	1.9	1.9	2.0	2.0
Total	54.1	56.8	53.6	55.5	55.5	55.2	55.3	55.3
Communications								
Premise Telecom	5.5	5.7	5.9	6.2	6.5	6.7	6.8	6.6
Public Telecom	2.1	2.0	1.9	2.0	2.0	2.0	2.0	1.8
Mobile Communications	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.8
Broadcast & Studio	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Other Communications	1.3	1.2	1.2	1.3	1.3	1.5	1.4	1.3
Total	10.1	10.1	10.2	10.7	11.0	11.5	11.4	10.9
Industrial								
Security & Energy Management	0.9	0.8	0.8	0.9	0.9	0.9	0.9	0.9
Manufacturing Systems/Instruments	2.2	2.1	2.2	2.3	2.4	2.5	2.5	2.4
Medical Equipment	1.8	1.6	1.7	1.8	1.8	1.9	1.9	1.8
Other Industrial	1.6	1.5	1.6	1.8	1.8	1.9	1.9	1.9
Total	10.6	9.7	10.1	10.8	11.1	11.8	11.9	11.5
Consumer								
Audio	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Video	1.4	1.5	1.5	1.6	1.5	1.5	1.5	1.6
Personal Electronics	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Appliances	4.2	4.2	4.3	4.6	4.6	4.7	4.9	5.2
Other Consumer	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.6
Total	6.5	6.7	6.7	7.2	7.2	7.3	7.5	7.9
Military/Aerospace	12.6	11.5	11.4	10.7	10.1	9.3	9.1	9.3
Transportation	6.0	5.3	5.4	5.1	5.1	4.9	4.9	5.0
Total Equipment	100.0	100.0	97.5	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (August 1991)

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Table 3c
Semiconductor Consumption Forecast
(Percentage of Application Market)

Company: All
Product: Each
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Data Processing								
Computers	73.4	74.5	73.4	72.5	72.2	71.3	70.3	68.6
Data Storage	10.8	9.3	9.9	9.3	7.7	6.7	6.1	6.2
Terminals	2.5	2.2	2.1	2.3	2.5	2.6	2.5	2.5
Input/Output	9.4	10.4	11.2	12.7	14.3	15.9	17.5	19.1
Dedicated	3.9	3.5	3.4	3.3	3.4	3.5	3.5	3.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Communications								
Premise Telecom	53.9	56.5	58.2	58.4	58.8	58.5	59.8	60.4
Public Telecom	20.8	19.8	18.8	18.4	18.1	17.6	17.2	16.7
Mobile Communications	7.4	7.2	7.1	7.3	7.4	7.4	7.6	7.7
Broadcast & Studio	4.8	4.4	4.1	3.9	3.8	3.6	3.5	3.3
Other Communications	13.1	12.2	11.9	11.9	12.0	13.0	12.0	11.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Industrial								
Security & Energy Management	8.2	7.8	8.0	7.9	8.0	8.0	7.9	8.0
Manufacturing Systems/Instruments	20.9	21.4	21.3	21.3	21.3	21.1	21.1	21.1
Medical Equipment	16.6	16.6	16.5	16.4	16.1	15.9	15.7	15.6
Other Industrial	14.8	15.3	15.9	16.2	16.2	16.1	16.2	16.1
Total	60.5	61.2	61.8	61.7	61.5	61.1	60.9	60.8
Consumer								
Audio	4.1	3.6	3.8	3.8	3.7	3.7	3.6	3.5
Video	21.0	22.3	22.5	22.1	21.5	21.1	20.7	20.3
Personal Electronics	2.2	2.3	2.4	2.4	2.3	2.3	2.3	2.3
Appliances	64.2	63.5	63.3	63.8	64.4	64.8	65.3	65.6
Other Consumer	8.5	8.3	8.0	7.9	8.0	8.1	8.2	8.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Military/Aerospace	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Transportation	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dataquest (August 1991)

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Table 4a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Data Processing
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	163,126	177,988	184,983	206,058	227,664	249,173	269,139	292,775	11.4	9.6
Total Semiconductor	23,504	27,517	26,991	30,555	35,397	40,027	44,126	47,645	13.2	12.0
Integrated Circuits	22,140	26,001	25,443	28,850	33,567	37,991	41,853	45,187	13.4	12.2
MOS Digital	17,394	21,428	20,712	23,865	28,280	32,414	36,103	39,307	15.2	13.7
MOS Memory	8,787	11,979	10,020	11,579	14,481	17,390	19,526	21,432	15.6	16.4
MOS Microcomponents	4,038	4,682	5,651	6,560	7,604	8,466	9,324	9,946	16.1	12.0
MOS Logic	4,569	4,767	5,041	5,726	6,195	6,558	7,253	7,929	13.6	9.5
Bipolar Digital	3,035	2,800	2,798	2,920	3,052	3,119	3,056	2,981	4.4	1.3
Bipolar Memory	416	318	285	280	279	280	265	250	-1.8	-2.6
Bipolar Logic	2,619	2,482	2,513	2,640	2,773	2,839	2,791	2,731	5.1	1.7
Analog	1,711	1,773	1,933	2,065	2,235	2,458	2,694	2,899	6.8	8.4
Discrete	801	808	818	878	937	1,030	1,119	1,204	7.3	8.0
Optoelectronics	563	708	729	827	894	1,006	1,154	1,254	13.4	11.5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 4b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Data Processing
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

Data Processing	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.144	.155	.146	.148	.155	.161	.164	.163
Integrated Circuits	.136	.146	.138	.140	.147	.152	.156	.154
MOS Digital	.107	.120	.112	.116	.124	.130	.134	.134
MOS Memory	.054	.067	.054	.056	.064	.070	.073	.073
MOS Microcomponents	.025	.026	.031	.032	.033	.034	.035	.034
MOS Logic	.028	.027	.027	.028	.027	.026	.027	.027
Bipolar Digital	.019	.016	.015	.014	.013	.013	.011	.010
Bipolar Memory	.003	.002	.002	.001	.001	.001	.001	.001
Bipolar Logic	.016	.014	.014	.013	.012	.011	.010	.009
Analog	.010	.010	.010	.010	.010	.010	.010	.010
Discrete	.005	.005	.004	.004	.004	.004	.004	.004
Optoelectronics	.003	.004	.004	.004	.004	.004	.004	.004

Source: Dataquest (August 1991)

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Table 5a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Computers
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	92,100	103,432	107,895	118,638	130,950	143,105	154,710	166,859	10.0	9.1
Total Semiconductor	13,418	16,323	16,151	18,037	21,064	23,525	25,328	27,088	11.7	10.9
Integrated Circuits	12,785	15,606	15,411	17,250	20,237	22,630	24,364	26,066	11.9	11.1
MOS Digital	10,306	13,222	12,969	14,684	17,491	19,788	21,523	23,263	13.2	12.4
MOS Memory	5,882	8,130	7,100	7,989	9,859	11,503	12,541	13,599	12.5	13.9
MOS Microcomponents	2,140	2,596	3,212	3,703	4,388	4,759	5,137	5,441	15.3	11.1
MOS Logic	2,284	2,496	2,657	2,992	3,244	3,526	3,845	4,223	12.6	9.7
Bipolar Digital	2,278	2,172	2,190	2,294	2,418	2,479	2,412	2,335	4.7	1.3
Bipolar Memory	288	228	200	192	191	190	177	165	-4.0	-3.8
Bipolar Logic	1,990	1,944	1,990	2,102	2,227	2,289	2,235	2,170	5.6	1.7
Analog	201	212	252	272	328	363	429	468	7.9	13.2
Discrete	425	443	453	475	498	541	584	616	4.9	6.3
Optoelectronics	208	274	287	312	329	354	380	406	8.7	7.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 5b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Computers
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

Computers	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.146	.158	.150	.152	.161	.164	.164	.162
Integrated Circuits	.139	.151	.143	.145	.155	.158	.157	.156
MOS Digital	.112	.128	.120	.124	.134	.138	.139	.139
MOS Memory	.064	.079	.066	.067	.075	.080	.081	.081
MOS Microcomponents	.023	.025	.030	.031	.034	.033	.033	.033
MOS Logic	.025	.024	.025	.025	.025	.025	.025	.025
Bipolar Digital	.025	.021	.020	.019	.018	.017	.016	.014
Bipolar Memory	.003	.002	.002	.002	.001	.001	.001	.001
Bipolar Logic	.022	.019	.018	.018	.017	.016	.014	.013
Analog	.002	.002	.002	.002	.003	.003	.003	.003
Discrete	.005	.004	.004	.004	.004	.004	.004	.004
Optoelectronics	.002	.003	.003	.003	.003	.002	.002	.002

Source: Dataquest (August 1991)

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Table 6a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Data Storage
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	19,676	21,162	21,534	23,999	25,620	27,915	29,836	31,942	11.4	8.2
Total Semiconductor	3,995	4,229	4,362	4,820	5,080	5,494	6,040	6,470	10.5	8.2
Integrated Circuits	3,798	4,015	4,142	4,588	4,844	5,242	5,768	6,169	10.8	8.3
MOS Digital	2,504	2,704	2,731	3,109	3,330	3,606	4,009	4,286	13.8	9.4
MOS Memory	429	563	411	519	692	873	1,005	1,102	26.3	21.8
MOS Microcomponents	853	946	1,089	1,212	1,277	1,444	1,579	1,679	11.3	9.0
MOS Logic	1,222	1,195	1,231	1,378	1,361	1,289	1,425	1,505	11.9	4.1
Bipolar Digital	210	182	182	174	163	162	164	168	-4.4	-1.6
Bipolar Memory	37	28	29	30	29	32	33	36	3.4	4.4
Bipolar Logic	173	154	153	144	134	130	131	132	-5.9	-2.9
Analog	1,084	1,129	1,229	1,305	1,351	1,474	1,595	1,715	6.2	6.9
Discrete	115	116	119	126	131	140	151	168	5.9	7.1
Optoelectronics	82	98	101	106	105	112	121	133	5.0	5.7

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 6b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Data Storage
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

Data Storage	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.203	.200	.203	.201	.198	.197	.202	.203
Integrated Circuits	.193	.190	.192	.191	.189	.188	.193	.193
MOS Digital	.127	.128	.127	.130	.130	.129	.134	.134
MOS Memory	.022	.027	.019	.022	.027	.031	.034	.035
MOS Microcomponents	.043	.045	.051	.051	.050	.052	.053	.053
MOS Logic	.062	.056	.057	.057	.053	.046	.048	.047
Bipolar Digital	.011	.009	.008	.007	.006	.006	.005	.005
Bipolar Memory	.002	.001	.001	.001	.001	.001	.001	.001
Bipolar Logic	.009	.007	.007	.006	.005	.005	.004	.004
Analog	.055	.053	.057	.054	.053	.053	.053	.054
Discrete	.006	.005	.006	.005	.005	.005	.005	.005
Optoelectronics	.004	.005	.005	.004	.004	.004	.004	.004

Source: Dataquest (August 1991)

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Table 7a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Terminals
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	14,048	14,183	14,929	17,693	19,677	21,637	23,581	26,284	18.5	12.0
Total Semiconductor	2,337	2,506	2,083	2,410	2,814	3,197	3,547	3,763	15.7	12.6
Integrated Circuits	2,135	2,312	1,907	2,213	2,605	2,971	3,312	3,521	16.0	13.0
MOS Digital	1,566	1,796	1,396	1,659	1,988	2,296	2,600	2,773	18.8	14.7
MOS Memory	850	1,088	653	787	993	1,211	1,384	1,484	20.5	17.8
MOS Microcomponents	359	363	411	480	545	614	689	740	16.8	12.5
MOS Logic	357	345	332	392	450	471	527	549	18.1	10.6
Bipolar Digital	243	189	174	190	201	210	211	212	9.2	4.0
Bipolar Memory	30	20	19	21	22	23	22	21	10.5	2.0
Bipolar Logic	213	169	155	169	179	187	189	191	9.0	4.3
Analog	326	327	337	364	416	465	501	536	8.0	9.7
Discrete	131	118	109	122	129	138	143	147	11.9	6.2
Optoelectronics	71	76	67	75	80	88	92	95	11.9	7.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 7b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Terminals
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

Terminals	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.166	.177	.140	.136	.143	.148	.150	.143
Integrated Circuits	.152	.163	.128	.125	.132	.137	.140	.134
MOS Digital	.111	.127	.094	.094	.101	.106	.110	.106
MOS Memory	.061	.077	.044	.044	.050	.056	.059	.056
MOS Microcomponents	.026	.026	.028	.027	.028	.028	.029	.028
MOS Logic	.025	.024	.022	.022	.023	.022	.022	.021
Bipolar Digital	.017	.013	.012	.011	.010	.010	.009	.008
Bipolar Memory	.002	.001	.001	.001	.001	.001	.001	.001
Bipolar Logic	.015	.012	.010	.010	.009	.009	.008	.007
Analog	.023	.023	.023	.021	.021	.021	.021	.020
Discrete	.009	.008	.007	.007	.007	.006	.006	.006
Optoelectronics	.005	.005	.004	.004	.004	.004	.004	.004

Source: Dataquest (August 1991)

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Table 8a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Input/Output
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	19,943	21,277	23,073	26,084	29,548	32,723	36,119	39,920	13.0	11.6
Total Semiconductor	2,133	2,687	2,671	3,302	4,105	5,099	6,201	7,137	23.6	21.7
Integrated Circuits	1,930	2,429	2,393	2,958	3,704	4,613	5,592	6,443	23.6	21.9
MOS Digital	1,698	2,213	2,169	2,716	3,443	4,339	5,305	6,148	25.2	23.2
MOS Memory	952	1,359	1,141	1,459	1,912	2,524	3,147	3,681	27.9	26.4
MOS Microcomponents	344	412	509	633	781	952	1,145	1,282	24.4	20.3
MOS Logic	402	442	519	624	750	863	1,013	1,185	20.2	18.0
Bipolar Digital	169	150	151	161	169	170	173	173	6.6	2.8
Bipolar Memory	31	23	21	23	24	23	22	18	9.5	-3.0
Bipolar Logic	138	127	130	138	145	147	151	155	6.2	3.6
Analog	63	66	73	81	92	104	114	122	11.0	10.8
Discrete	68	70	75	88	105	128	153	181	17.3	19.3
Optoelectronics	135	188	203	256	296	358	456	513	26.1	20.4

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 8b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Input/Output
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

Input/Output	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.107	.126	.116	.127	.139	.156	.172	.179
Integrated Circuits	.097	.114	.104	.113	.125	.141	.155	.161
MOS Digital	.085	.104	.094	.104	.117	.133	.147	.154
MOS Memory	.048	.064	.049	.056	.065	.077	.087	.092
MOS Microcomponents	.017	.019	.022	.024	.026	.029	.032	.032
MOS Logic	.020	.021	.022	.024	.025	.026	.028	.030
Bipolar Digital	.008	.007	.007	.006	.006	.005	.005	.004
Bipolar Memory	.002	.001	.001	.001	.001	.001	.001	.000
Bipolar Logic	.007	.006	.006	.005	.005	.004	.004	.004
Analog	.003	.003	.003	.003	.003	.003	.003	.003
Discrete	.003	.003	.003	.003	.004	.004	.004	.005
Optoelectronics	.007	.009	.009	.010	.010	.011	.013	.013

Source: Dataquest (August 1991)

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Table 9a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Dedicated Systems
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	17,359	17,935	17,552	19,643	21,869	23,793	24,893	27,770	11.9	9.6
Total Semiconductor	1,621	1,772	1,723	1,986	2,335	2,712	3,010	3,187	15.3	13.1
Integrated Circuits	1,492	1,639	1,590	1,841	2,177	2,535	2,817	2,988	15.8	13.4
MOS Digital	1,320	1,493	1,447	1,697	2,028	2,385	2,666	2,837	17.3	14.4
MOS Memory	674	839	715	825	1,025	1,279	1,449	1,566	15.4	17.0
MOS Microcomponents	342	365	430	532	613	697	774	804	23.7	13.3
MOS Logic	304	289	302	340	390	409	443	467	12.6	9.1
Bipolar Digital	135	107	101	101	101	98	96	93	0	-1.6
Bipolar Memory	30	19	16	14	13	12	11	10	-12.5	-9.0
Bipolar Logic	105	88	85	87	88	86	85	83	2.4	-0.5
Analog	37	39	42	43	48	52	55	58	2.4	6.7
Discrete	62	61	62	67	74	83	88	92	8.1	8.2
Optoelectronics	67	72	71	78	84	94	105	107	9.9	8.5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 9b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Dedicated Systems
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

Dedicated Systems	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.093	.099	.098	.101	.107	.114	.121	.115
Integrated Circuits	.086	.091	.091	.094	.100	.107	.113	.108
MOS Digital	.076	.083	.082	.086	.093	.100	.107	.102
MOS Memory	.039	.047	.041	.042	.047	.054	.058	.056
MOS Microcomponents	.020	.020	.024	.027	.028	.029	.031	.029
MOS Logic	.018	.016	.017	.017	.018	.017	.018	.017
Bipolar Digital	.008	.006	.006	.005	.005	.004	.004	.003
Bipolar Memory	.002	.001	.001	.001	.001	.001	.000	.000
Bipolar Logic	.006	.005	.005	.004	.004	.004	.003	.003
Analog	.002	.002	.002	.002	.002	.002	.002	.002
Discrete	.004	.003	.004	.003	.003	.003	.004	.003
Optoelectronics	.004	.004	.004	.004	.004	.004	.004	.004

Source: Dataquest (August 1991)

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Table 10a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Communications
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	81,731	87,206	95,984	106,477	116,482	126,603	135,088	146,753	10.9	8.9
Total Semiconductor	6,849	7,638	7,848	9,213	11,195	13,857	15,402	15,938	17.4	15.2
Integrated Circuits	5,234	5,953	6,054	7,185	9,085	11,453	12,892	13,487	18.7	17.4
MOS Digital	3,214	4,027	3,847	4,789	6,413	8,391	9,519	9,863	24.5	20.7
MOS Memory	1,061	1,782	1,072	1,193	1,539	2,090	2,482	2,532	11.3	18.8
MOS Microcomponents	917	1,080	1,470	1,949	2,666	3,496	4,105	4,451	32.6	24.8
MOS Logic	1,236	1,165	1,305	1,647	2,208	2,805	2,932	2,880	26.2	17.2
Bipolar Digital	562	382	387	394	356	348	307	266	1.8	-7.2
Bipolar Memory	63	45	39	33	30	32	27	23	-15.4	-10.0
Bipolar Logic	499	338	349	361	326	316	280	243	3.4	-7.0
Analog	1,458	1,544	1,820	2,002	2,316	2,714	3,066	3,358	10.0	13.0
Discrete	1,126	1,092	1,193	1,319	1,389	1,629	1,669	1,597	10.6	6.0
Optoelectronics	489	593	601	709	721	775	841	854	18.0	7.3

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 10b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Communications
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.084	.088	.082	.087	.096	.109	.114	.109
Integrated Circuits	.064	.068	.063	.067	.078	.090	.095	.092
MOS Digital	.039	.046	.040	.045	.055	.066	.070	.067
MOS Memory	.013	.020	.011	.011	.013	.017	.018	.017
MOS Microcomponents	.011	.012	.015	.018	.023	.028	.030	.030
MOS Logic	.015	.013	.014	.015	.019	.022	.022	.020
Bipolar Digital	.007	.004	.004	.004	.003	.003	.002	.002
Bipolar Memory	.001	.001	0	0	0	0	0	0
Bipolar Logic	.006	.004	.004	.003	.003	.002	.002	.002
Analog	.018	.018	.019	.019	.020	.021	.023	.023
Discrete	.014	.013	.012	.012	.012	.013	.012	.011
Optoelectronics	.006	.007	.006	.007	.006	.006	.006	.006

Source: Dataquest (August 1991)

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Table 11a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Premise Telecom
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	31,405	35,990	38,755	42,953	47,288	51,031	54,544	59,830	10.8	9.1
Total Semiconductor	3,508	4,028	4,212	4,967	6,113	7,595	8,554	8,928	17.9	16.2
Integrated Circuits	2,807	3,289	3,417	4,105	5,241	6,618	7,556	7,938	20.1	18.4
MOS Digital	1,873	2,387	2,370	2,975	3,968	5,150	5,937	6,171	25.5	21.1
MOS Memory	594	1,031	635	696	885	1,186	1,429	1,455	9.6	18.0
MOS Microcomponents	651	763	1,059	1,426	1,942	2,565	3,059	3,329	34.7	25.7
MOS Logic	628	593	676	853	1,141	1,399	1,449	1,387	26.2	15.5
Bipolar Digital	251	169	171	172	152	149	142	133	0.6	-4.9
Bipolar Memory	13	9	8	7	6	7	5	4	-12.5	-12.9
Bipolar Logic	238	160	163	165	146	142	137	129	1.2	-4.6
Analog	683	733	876	958	1,121	1,319	1,477	1,634	9.4	13.3
Discrete	529	523	575	607	623	718	725	720	5.6	4.6
Optoelectronics	172	216	220	255	249	259	273	270	15.9	4.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 11b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Premise Telecom
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.112	.112	.109	.116	.129	.149	.157	.149
Integrated Circuits	.089	.091	.088	.096	.111	.130	.139	.133
MOS Digital	.060	.066	.061	.069	.084	.101	.109	.103
MOS Memory	.019	.029	.016	.016	.019	.023	.026	.024
MOS Microcomponents	.021	.021	.027	.033	.041	.050	.056	.056
MOS Logic	.020	.016	.017	.020	.024	.027	.027	.023
Bipolar Digital	.008	.005	.004	.004	.003	.003	.003	.002
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.008	.004	.004	.004	.003	.003	.003	.002
Analog	.022	.020	.023	.022	.024	.026	.027	.027
Discrete	.017	.015	.015	.014	.013	.014	.013	.012
Optoelectronics	.005	.006	.006	.006	.005	.005	.005	.005

Source: Dataquest (August 1991)

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Table 12a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Public Telecom
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	24,616	24,475	27,732	31,089	33,983	37,127	39,317	42,375	12.1	8.8
Total Semiconductor	1,550	1,702	1,695	1,977	2,388	2,949	3,230	3,320	16.6	14.4
Integrated Circuits	1,116	1,253	1,228	1,443	1,836	2,309	2,567	2,679	17.5	16.9
MOS Digital	744	908	838	1,024	1,372	1,781	1,996	2,068	22.2	19.8
MOS Memory	254	408	249	279	369	492	605	633	12.0	20.5
MOS Microcomponents	147	177	227	287	394	497	556	596	26.4	21.3
MOS Logic	343	323	362	458	609	792	835	839	26.5	18.3
Bipolar Digital	92	60	63	61	55	53	43	33	-3.2	-12.1
Bipolar Memory	14	10	9	7	7	8	7	6	-22.2	-7.8
Bipolar Logic	78	50	54	54	48	45	36	27	0	-12.9
Analog	280	285	327	358	409	475	528	578	9.5	12.1
Discrete	274	256	271	300	317	387	397	373	10.7	6.6
Optoelectronics	160	193	196	234	235	253	266	268	19.4	6.5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 12b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Public Telecom
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.063	.070	.061	.064	.070	.079	.082	.078
Integrated Circuits	.045	.051	.044	.046	.054	.062	.065	.063
MOS Digital	.030	.037	.030	.033	.040	.048	.051	.049
MOS Memory	.010	.017	.009	.009	.011	.013	.015	.015
MOS Microcomponents	.006	.007	.008	.009	.012	.013	.014	.014
MOS Logic	.014	.013	.013	.015	.018	.021	.021	.020
Bipolar Digital	.004	.002	.002	.002	.002	.001	.001	.001
Bipolar Memory	.001	0	0	0	0	0	0	0
Bipolar Logic	.003	.002	.002	.002	.001	.001	.001	.001
Analog	.011	.012	.012	.012	.012	.013	.013	.014
Discrete	.011	.010	.010	.010	.009	.010	.010	.009
Optoelectronics	.006	.008	.007	.008	.007	.007	.007	.006

Source: Dataquest (August 1991)

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Table 13a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Mobile Communications
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	14,450	15,074	16,785	18,620	20,308	22,389	24,237	26,473	10.9	9.5
Total Semiconductor	1,058	1,116	1,138	1,330	1,563	1,921	2,167	2,235	16.9	14.5
Integrated Circuits	762	808	813	939	1,150	1,436	1,633	1,705	15.5	16.0
MOS Digital	276	343	272	332	454	628	729	744	22.1	22.3
MOS Memory	102	166	76	91	123	178	228	225	19.7	24.2
MOS Microcomponents	58	68	85	103	143	199	232	254	21.2	24.5
MOS Logic	116	109	111	138	188	251	269	265	24.3	19.0
Bipolar Digital	130	90	92	99	93	93	79	66	7.6	-6.4
Bipolar Memory	21	15	12	11	10	11	10	9	-8.3	-5.6
Bipolar Logic	109	75	80	88	83	82	69	57	10.0	-6.6
Analog	356	375	449	508	603	715	825	895	13.1	14.8
Discrete	194	184	200	238	251	296	312	295	19.0	8.1
Optoelectronics	102	124	125	153	162	189	222	235	22.4	13.5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 13b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Mobile Communications
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.073	.074	.068	.071	.077	.086	.089	.084
Integrated Circuits	.053	.054	.048	.050	.057	.064	.067	.064
MOS Digital	.019	.023	.016	.018	.022	.028	.030	.028
MOS Memory	.007	.011	.005	.005	.006	.008	.009	.008
MOS Microcomponents	.004	.005	.005	.006	.007	.009	.010	.010
MOS Logic	.008	.007	.007	.007	.009	.011	.011	.010
Bipolar Digital	.009	.006	.005	.005	.005	.004	.003	.002
Bipolar Memory	.001	.001	.001	.001	0	0	0	0
Bipolar Logic	.008	.005	.005	.005	.004	.004	.003	.002
Analog	.025	.025	.027	.027	.030	.032	.034	.034
Discrete	.013	.012	.012	.013	.012	.013	.013	.011
Optoelectronics	.007	.008	.007	.008	.008	.008	.009	.009

Source: Dataquest (August 1991)

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Table 14a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Broadcast & Studio
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	3,435	3,682	4,079	4,459	4,800	5,145	5,457	5,878	9.3	7.6
Total Semiconductor	188	206	203	239	285	337	368	379	17.7	13.3
Integrated Circuits	139	155	150	178	220	275	305	316	18.7	16.1
MOS Digital	83	101	92	114	154	202	227	236	23.9	20.7
MOS Memory	30	48	29	32	41	58	69	70	10.3	19.3
MOS Microcomponents	16	18	24	33	47	57	64	68	37.5	23.2
MOS Logic	37	35	39	49	66	87	94	98	25.6	20.2
Bipolar Digital	25	18	17	17	15	14	11	9	0	-11.9
Bipolar Memory	6	5	4	4	3	3	2	2	0	-12.9
Bipolar Logic	19	13	13	13	12	11	9	7	0	-11.6
Analog	31	36	41	47	51	59	67	71	14.6	11.6
Discrete	34	35	38	43	46	49	48	46	13.2	3.9
Optoelectronics	15	16	15	18	19	13	15	17	20.0	2.5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 14b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Broadcast & Studio
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.055	.056	.050	.054	.059	.066	.067	.064
Integrated Circuits	.040	.042	.037	.040	.046	.053	.056	.054
MOS Digital	.024	.027	.023	.026	.032	.039	.042	.040
MOS Memory	.009	.013	.007	.007	.009	.011	.013	.012
MOS Microcomponents	.005	.005	.006	.007	.010	.011	.012	.012
MOS Logic	.011	.010	.010	.011	.014	.017	.017	.017
Bipolar Digital	.007	.005	.004	.004	.003	.003	.002	.002
Bipolar Memory	.002	.001	.001	.001	.001	.001	0	0
Bipolar Logic	.006	.004	.003	.003	.003	.002	.002	.001
Analog	.009	.010	.010	.011	.011	.011	.012	.012
Discrete	.010	.010	.009	.010	.010	.010	.009	.008
Optoelectronics	.004	.004	.004	.004	.004	.003	.003	.003

Source: Dataquest (August 1991)

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Table 15a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Other Communications
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	7,825	7,985	8,633	9,356	10,103	10,911	11,533	12,197	8.4	7.2
Total Semiconductor	545	587	601	701	846	1,056	1,083	1,077	16.6	12.4
Integrated Circuits	410	449	447	521	638	816	831	850	16.6	13.7
MOS Digital	238	288	275	344	465	630	630	644	25.1	18.6
MOS Memory	81	129	83	95	121	176	151	149	14.5	12.4
MOS Microcomponents	45	54	75	100	140	178	194	204	33.3	22.2
MOS Logic	112	105	117	149	204	276	285	291	27.4	20.0
Bipolar Digital	64	46	45	46	41	40	32	26	2.2	-10.4
Bipolar Memory	9	6	6	5	4	4	3	3	-16.7	-12.9
Bipolar Logic	55	40	39	41	37	36	29	23	5.1	-10.0
Analog	108	115	127	131	132	146	169	180	3.1	7.2
Discrete	95	94	109	131	152	179	187	163	20.2	8.4
Optoelectronics	40	44	45	49	56	61	65	64	8.9	7.3

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 15b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Other Communications
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.070	.074	.070	.075	.084	.097	.094	.088
Integrated Circuits	.052	.056	.052	.056	.063	.075	.072	.070
MOS Digital	.030	.036	.032	.037	.046	.058	.055	.053
MOS Memory	.010	.016	.010	.010	.012	.016	.013	.012
MOS Microcomponents	.006	.007	.009	.011	.014	.016	.017	.017
MOS Logic	.014	.013	.014	.016	.020	.025	.025	.024
Bipolar Digital	.008	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	.001	.001	0	0	0	0
Bipolar Logic	.007	.005	.005	.004	.004	.003	.003	.002
Analog	.014	.014	.015	.014	.013	.013	.015	.015
Discrete	.012	.012	.013	.014	.015	.016	.016	.013
Optoelectronics	.005	.006	.005	.005	.006	.006	.006	.005

Source: Dataquest (August 1991)

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Table 16a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Industrial
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	83,909	88,262	93,037	100,343	108,517	117,085	124,255	132,717	7.9	7.4
Total Semiconductor	4,828	5,255	5,649	6,829	8,010	9,818	10,813	11,020	20.9	14.3
Integrated Circuits	2,821	3,093	3,329	4,108	5,127	6,547	7,386	7,588	23.4	17.9
MOS Digital	1,299	1,680	1,774	2,336	3,268	4,505	5,209	5,403	31.7	25.0
MOS Memory	269	477	311	381	527	732	888	933	22.5	24.6
MOS Microcomponents	451	566	743	1,003	1,388	1,860	2,161	2,242	35.0	24.7
MOS Logic	579	637	720	952	1,353	1,913	2,160	2,228	32.2	25.3
Bipolar Digital	657	498	468	510	444	412	358	308	9.0	-8.0
Bipolar Memory	100	72	57	55	55	58	52	46	-3.5	-4.2
Bipolar Logic	557	426	411	455	389	354	306	262	10.7	-8.6
Analog	865	915	1,087	1,262	1,415	1,630	1,819	1,877	16.1	11.5
Discrete	1,579	1,640	1,785	2,133	2,224	2,543	2,622	2,576	19.5	7.6
Optoelectronics	428	522	536	588	660	728	805	856	9.7	9.8

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 16b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Industrial
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.058	.060	.061	.068	.074	.084	.087	.083
Integrated Circuits	.034	.035	.036	.041	.047	.056	.059	.057
MOS Digital	.015	.019	.019	.023	.030	.038	.042	.041
MOS Memory	.003	.005	.003	.004	.005	.006	.007	.007
MOS Microcomponents	.005	.006	.008	.010	.013	.016	.017	.017
MOS Logic	.007	.007	.008	.009	.012	.016	.017	.017
Bipolar Digital	.008	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	.001	.001	.001	0	0	0
Bipolar Logic	.007	.005	.004	.005	.004	.003	.002	.002
Analog	.010	.010	.012	.013	.013	.014	.015	.014
Discrete	.019	.019	.019	.021	.020	.022	.021	.019
Optoelectronics	.005	.006	.006	.006	.006	.006	.006	.006

Source: Dataquest (August 1991)

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Table 17a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Security & Energy Management
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	6,435	6,849	7,560	8,291	9,046	9,961	10,995	12,178	9.7	10.0
Total Semiconductor	251	256	272	331	408	517	571	597	21.7	17.0
Integrated Circuits	168	174	193	241	308	394	449	479	24.9	19.9
MOS Digital	63	72	80	113	166	235	276	301	41.3	30.3
MOS Memory	10	16	10	12	15	19	23	24	20.0	19.1
MOS Microcomponents	12	14	19	26	39	56	68	82	36.8	34.0
MOS Logic	41	42	51	75	112	160	185	195	47.1	30.8
Bipolar Digital	47	34	33	35	31	26	22	19	6.1	-10.5
Bipolar Memory	6	4	4	3	3	2	2	2	-25.0	-12.9
Bipolar Logic	41	30	29	32	28	24	20	17	10.3	-10.1
Analog	58	68	80	93	111	133	151	159	16.3	14.7
Discrete	74	72	68	78	86	106	103	98	14.7	7.6
Optoelectronics	9	10	11	12	14	17	19	20	9.1	12.7

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 17b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Security & Energy Management
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.039	.037	.036	.040	.045	.052	.052	.049
Integrated Circuits	.026	.025	.026	.029	.034	.040	.041	.039
MOS Digital	.010	.011	.011	.014	.018	.024	.025	.025
MOS Memory	.002	.002	.001	.001	.002	.002	.002	.002
MOS Microcomponents	.002	.002	.003	.003	.004	.006	.006	.007
MOS Logic	.006	.006	.007	.009	.012	.016	.017	.016
Bipolar Digital	.007	.005	.004	.004	.003	.003	.002	.002
Bipolar Memory	.001	.001	.001	0	0	0	0	0
Bipolar Logic	.006	.004	.004	.004	.003	.002	.002	.001
Analog	.009	.010	.011	.011	.012	.013	.014	.013
Discrete	.011	.011	.009	.009	.010	.011	.009	.008
Optoelectronics	.001	.001	.001	.001	.002	.002	.002	.002

Source: Dataquest (August 1991)

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Table 18a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Manufacturing Systems
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	17,592	19,887	21,360	22,958	24,960	27,176	28,838	30,670	7.5	7.5
Total Semiconductor	1,256	1,399	1,528	1,866	2,265	2,841	3,103	3,133	22.1	15.4
Integrated Circuits	631	729	817	1,074	1,423	1,894	2,121	2,197	31.5	21.9
MOS Digital	365	483	549	766	1,123	1,593	1,815	1,895	39.5	28.1
MOS Memory	66	123	84	110	161	233	248	255	31.0	24.9
MOS Microcomponents	149	185	254	354	504	689	804	857	39.4	27.5
MOS Logic	150	175	211	302	458	671	763	783	43.1	30.0
Bipolar Digital	150	125	124	139	116	110	102	96	12.1	-5.0
Bipolar Memory	26	19	15	14	13	12	11	10	-6.7	-7.8
Bipolar Logic	124	106	109	125	103	98	91	86	14.7	-4.6
Analog	116	121	144	169	184	191	204	206	17.4	7.4
Discrete	464	481	525	591	611	691	701	634	12.6	3.8
Optoelectronics	161	189	186	201	231	256	281	302	8.1	10.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 18b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Manufacturing Systems
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.071	.070	.072	.081	.091	.105	.108	.102
Integrated Circuits	.036	.037	.038	.047	.057	.070	.074	.072
MOS Digital	.021	.024	.026	.033	.045	.059	.063	.062
MOS Memory	.004	.006	.004	.005	.006	.009	.009	.008
MOS Microcomponents	.008	.009	.012	.015	.020	.025	.028	.028
MOS Logic	.009	.009	.010	.013	.018	.025	.026	.026
Bipolar Digital	.009	.006	.006	.006	.005	.004	.004	.003
Bipolar Memory	.001	.001	.001	.001	.001	0	0	0
Bipolar Logic	.007	.005	.005	.005	.004	.004	.003	.003
Analog	.007	.006	.007	.007	.007	.007	.007	.007
Discrete	.026	.024	.025	.026	.024	.025	.024	.021
Optoelectronics	.009	.010	.009	.009	.009	.009	.010	.010

Source: Dataquest (August 1991)

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Table 19a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Instrumentation
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	33,326	33,558	35,590	38,349	41,364	44,322	46,740	49,705	7.8	6.9
Total Semiconductor	1,624	1,762	1,901	2,294	2,644	3,163	3,434	3,454	20.7	12.7
Integrated Circuits	983	1,076	1,152	1,388	1,680	2,066	2,304	2,312	20.5	14.9
MOS Digital	449	606	636	811	1,091	1,434	1,661	1,680	27.5	21.4
MOS Memory	109	198	132	164	230	321	423	449	24.2	27.7
MOS Microcomponents	229	291	369	478	629	797	872	853	29.5	18.2
MOS Logic	111	117	135	169	232	316	366	378	25.2	22.9
Bipolar Digital	243	175	166	184	155	141	120	101	10.8	-9.5
Bipolar Memory	32	22	18	19	18	19	16	15	5.6	-3.6
Bipolar Logic	211	153	148	165	137	122	104	86	11.5	-10.3
Analog	291	295	350	393	434	491	523	531	12.3	8.7
Discrete	523	545	603	743	788	906	921	922	23.2	8.9
Optoelectronics	118	141	146	163	176	191	209	220	11.6	8.5

Note: Some columns do not add to totals shown because of rounding.
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Table 19b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Instrumentation
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.049	.053	.053	.060	.064	.071	.073	.069
Integrated Circuits	.029	.032	.032	.036	.041	.047	.049	.047
MOS Digital	.013	.018	.018	.021	.026	.032	.036	.034
MOS Memory	.003	.006	.004	.004	.006	.007	.009	.009
MOS Microcomponents	.007	.009	.010	.012	.015	.018	.019	.017
MOS Logic	.003	.003	.004	.004	.006	.007	.008	.008
Bipolar Digital	.007	.005	.005	.005	.004	.003	.003	.002
Bipolar Memory	.001	.001	.001	0	0	0	0	0
Bipolar Logic	.006	.005	.004	.004	.003	.003	.002	.002
Analog	.009	.009	.010	.010	.010	.011	.011	.011
Discrete	.016	.016	.017	.019	.019	.020	.020	.019
Optoelectronics	.004	.004	.004	.004	.004	.004	.004	.004

Source: Dataquest (August 1991)

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Table 20a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Medical Equipment
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	15,128	15,809	16,173	17,498	18,840	20,226	21,488	22,981	8.2	7.3
Total Semiconductor	762	815	852	1,008	1,193	1,473	1,669	1,736	18.3	15.3
Integrated Circuits	506	538	559	675	837	1,079	1,248	1,305	20.8	18.5
MOS Digital	226	278	273	346	484	682	817	878	26.7	26.3
MOS Memory	48	81	50	57	74	100	124	133	14.0	21.6
MOS Microcomponents	38	49	65	94	142	213	294	339	44.6	39.1
MOS Logic	140	148	158	195	268	369	399	406	23.4	20.8
Bipolar Digital	121	89	80	84	79	75	63	49	5.0	-9.3
Bipolar Memory	19	14	11	9	10	11	10	7	-18.2	-8.6
Bipolar Logic	102	75	69	75	69	64	53	42	8.7	-9.5
Analog	159	171	206	245	274	322	368	378	18.9	12.9
Discrete	209	216	230	262	274	301	317	318	13.9	6.7
Optoelectronics	47	61	63	71	82	93	104	113	12.7	12.4

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 20b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Medical Equipment
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.050	.052	.053	.058	.063	.073	.078	.076
Integrated Circuits	.033	.034	.035	.039	.044	.053	.058	.057
MOS Digital	.015	.018	.017	.020	.026	.034	.038	.038
MOS Memory	.003	.005	.003	.003	.004	.005	.006	.006
MOS Microcomponents	.003	.003	.004	.005	.008	.011	.014	.015
MOS Logic	.009	.009	.010	.011	.014	.018	.019	.018
Bipolar Digital	.008	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	.001	.001	.001	.001	0	0
Bipolar Logic	.007	.005	.004	.004	.004	.003	.002	.002
Analog	.011	.011	.013	.014	.015	.016	.017	.016
Discrete	.014	.014	.014	.015	.015	.015	.015	.014
Optoelectronics	.003	.004	.004	.004	.004	.005	.005	.005

Source: Dataquest (August 1991)

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Table 21a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Other Industrial
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	11,428	12,159	12,354	13,247	14,307	15,400	16,194	17,183	7.2	6.8
Total Semiconductor	935	1,023	1,097	1,330	1,501	1,824	2,036	2,100	21.2	13.9
Integrated Circuits	533	576	608	730	879	1,114	1,264	1,295	20.1	16.3
MOS Digital	196	241	236	300	404	561	640	649	27.1	22.4
MOS Memory	36	59	35	38	47	59	70	72	8.6	15.5
MOS Microcomponents	23	27	36	51	74	105	123	111	41.7	25.3
MOS Logic	137	155	165	211	283	397	447	466	27.9	23.1
Bipolar Digital	96	75	65	68	63	60	51	43	4.6	-7.9
Bipolar Memory	17	13	9	10	11	14	13	12	11.1	5.9
Bipolar Logic	79	62	56	58	52	46	38	31	3.6	-11.2
Analog	241	260	307	362	412	493	573	603	17.9	14.5
Discrete	309	326	359	459	465	539	580	604	27.9	11.0
Optoelectronics	93	121	130	141	157	171	192	201	8.5	9.1

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 21b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Other Industrial
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.082	.084	.089	.100	.105	.118	.126	.122
Integrated Circuits	.047	.047	.049	.055	.061	.072	.078	.075
MOS Digital	.017	.020	.019	.023	.028	.036	.040	.038
MOS Memory	.003	.005	.003	.003	.003	.004	.004	.004
MOS Microcomponents	.002	.002	.003	.004	.005	.007	.008	.006
MOS Logic	.012	.013	.013	.016	.020	.026	.028	.027
Bipolar Digital	.008	.006	.005	.005	.004	.004	.003	.003
Bipolar Memory	.001	.001	.001	.001	.001	.001	.001	.001
Bipolar Logic	.007	.005	.005	.004	.004	.003	.002	.002
Analog	.021	.021	.025	.027	.029	.032	.035	.035
Discrete	.027	.027	.029	.035	.033	.035	.036	.035
Optoelectronics	.008	.010	.011	.011	.011	.011	.012	.012

Source: Dataquest (August 1991)

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Table 22a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Consumer
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	122,665	126,999	136,067	147,931	161,298	170,161	179,872	192,714	8.7	7.2
Total Semiconductor	10,520	11,375	12,098	13,785	16,049	18,846	20,913	22,344	13.9	13.1
Integrated Circuits	6,837	7,640	8,073	9,427	11,373	13,902	15,600	16,867	16.8	15.9
MOS Digital	2,650	3,238	3,173	3,802	5,026	6,599	7,249	7,770	19.8	19.6
MOS Memory	1,041	1,520	1,122	1,235	1,599	2,060	2,361	2,484	10.1	17.2
MOS Microcomponents	968	1,081	1,357	1,739	2,282	3,023	3,285	3,650	28.2	21.9
MOS Logic	641	637	694	828	1,145	1,516	1,603	1,636	19.3	18.7
Bipolar Digital	344	278	275	298	312	309	278	245	8.4	-2.3
Bipolar Memory	7	7	5	4	3	2	2	2	-20.0	-16.7
Bipolar Logic	337	271	270	294	309	307	276	243	8.9	-2.1
Analog	3,843	4,124	4,625	5,327	6,035	6,994	8,073	8,852	15.2	13.9
Discrete	3,218	3,171	3,456	3,742	3,999	4,225	4,519	4,636	8.3	6.1
Optoelectronics	465	565	569	615	677	719	794	843	8.1	8.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 22b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Consumer
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.086	.090	.089	.093	.099	.111	.116	.116
Integrated Circuits	.056	.060	.059	.064	.071	.082	.087	.088
MOS Digital	.022	.025	.023	.026	.031	.039	.040	.040
MOS Memory	.008	.012	.008	.008	.010	.012	.013	.013
MOS Microcomponents	.008	.009	.010	.012	.014	.018	.018	.019
MOS Logic	.005	.005	.005	.006	.007	.009	.009	.008
Bipolar Digital	.003	.002	.002	.002	.002	.002	.002	.001
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.003	.002	.002	.002	.002	.002	.002	.001
Analog	.031	.032	.034	.036	.037	.041	.045	.046
Discrete	.026	.025	.025	.025	.025	.025	.025	.024
Optoelectronics	.004	.004	.004	.004	.004	.004	.004	.004

Source: Dataquest (August 1991)

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Table 23a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Audio
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	16,228	16,110	17,150	18,682	19,921	20,846	21,334	22,747	8.9	5.8
Total Semiconductor	1,503	1,565	1,722	1,956	2,229	2,614	2,894	3,087	13.6	12.4
Integrated Circuits	939	992	1,110	1,287	1,523	1,867	2,109	2,275	15.9	15.4
MOS Digital	298	348	395	490	647	859	953	1,016	24.1	20.8
MOS Memory	82	113	90	95	111	143	167	178	5.6	14.6
MOS Microcomponents	141	163	224	298	407	551	605	641	33.0	23.4
MOS Logic	75	72	81	97	129	165	181	197	19.8	19.5
Bipolar Digital	59	29	30	29	27	25	21	17	-3.3	-10.7
Bipolar Memory	0	0	0	0	0	0	0	0	0	0
Bipolar Logic	59	29	30	29	27	25	21	17	-3.3	-10.7
Analog	582	615	685	768	849	983	1,135	1,242	12.1	12.6
Discrete	515	513	551	602	627	660	691	713	9.3	5.3
Optoelectronics	49	60	61	67	79	87	94	99	9.8	10.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 23b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Audio
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.093	.097	.100	.105	.112	.125	.136	.136
Integrated Circuits	.058	.062	.065	.069	.076	.090	.099	.100
MOS Digital	.018	.022	.023	.026	.032	.041	.045	.045
MOS Memory	.005	.007	.005	.005	.006	.007	.008	.008
MOS Microcomponents	.009	.010	.013	.016	.020	.026	.028	.028
MOS Logic	.005	.004	.005	.005	.006	.008	.008	.009
Bipolar Digital	.004	.002	.002	.002	.001	.001	.001	.001
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.004	.002	.002	.002	.001	.001	.001	.001
Analog	.036	.038	.040	.041	.043	.047	.053	.055
Discrete	.032	.032	.032	.032	.031	.032	.032	.031
Optoelectronics	.003	.004	.004	.004	.004	.004	.004	.004

Source: Dataquest (August 1991)

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Table 24a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Video
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	40,725	40,709	43,866	46,529	51,201	53,911	57,713	61,820	6.1	7.1
Total Semiconductor	4,151	4,481	4,653	5,165	5,918	6,810	7,516	7,914	11.0	11.2
Integrated Circuits	2,442	2,695	2,773	3,165	3,794	4,581	5,119	5,456	14.1	14.5
MOS Digital	973	1,193	1,161	1,377	1,801	2,342	2,548	2,670	18.6	18.1
MOS Memory	391	585	442	482	611	785	878	911	9.0	15.6
MOS Microcomponents	329	361	458	591	768	981	1,069	1,155	29.0	20.3
MOS Logic	253	247	261	304	422	576	601	604	16.5	18.3
Bipolar Digital	110	89	81	98	106	98	87	75	21.0	-1.5
Bipolar Memory	5	5	4	3	2	1	1	1	-25.0	-24.2
Bipolar Logic	105	84	77	95	104	97	86	74	23.4	-0.8
Analog	1,359	1,413	1,531	1,690	1,887	2,141	2,484	2,711	10.4	12.1
Discrete	1,500	1,533	1,620	1,719	1,817	1,901	2,021	2,058	6.1	4.9
Optoelectronics	209	253	260	281	307	328	376	400	8.1	9.0

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 24b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Video
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.102	.110	.106	.111	.116	.126	.130	.128
Integrated Circuits	.060	.066	.063	.068	.074	.085	.089	.088
MOS Digital	.024	.029	.026	.030	.035	.043	.044	.043
MOS Memory	.010	.014	.010	.010	.012	.015	.015	.015
MOS Microcomponents	.008	.009	.010	.013	.015	.018	.019	.019
MOS Logic	.006	.006	.006	.007	.008	.011	.010	.010
Bipolar Digital	.003	.002	.002	.002	.002	.002	.002	.001
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.003	.002	.002	.002	.002	.002	.001	.001
Analog	.033	.035	.035	.036	.037	.040	.043	.044
Discrete	.037	.038	.037	.037	.035	.035	.035	.033
Optoelectronics	.005	.006	.006	.006	.006	.006	.007	.006

Source: Dataquest (August 1991)

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Table 25a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Personal Electronics
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	13,473	14,694	17,627	19,233	21,136	22,178	22,656	23,939	9.1	6.3
Total Semiconductor	1,112	1,222	1,375	1,614	1,900	2,257	2,516	2,743	17.4	14.8
Integrated Circuits	805	897	1,012	1,211	1,453	1,784	2,015	2,220	19.7	17.0
MOS Digital	264	319	332	416	554	737	827	927	25.3	22.8
MOS Memory	84	130	102	118	138	187	229	247	15.7	19.3
MOS Microcomponents	118	124	156	210	287	381	423	501	34.6	26.3
MOS Logic	62	65	74	88	129	169	175	179	18.9	19.3
Bipolar Digital	65	54	58	59	61	68	61	52	1.7	-2.2
Bipolar Memory	0	0	0	0	0	0	0	0	0	0
Bipolar Logic	65	54	58	59	61	68	61	52	1.7	-2.2
Analog	476	524	622	736	838	979	1,127	1,241	18.3	14.8
Discrete	226	229	265	300	335	358	377	392	13.2	8.1
Optoelectronics	81	96	98	103	112	115	124	131	5.1	6.0

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 25b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Personal Electronics
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.083	.083	.078	.084	.090	.102	.111	.115
Integrated Circuits	.060	.061	.057	.063	.069	.080	.089	.093
MOS Digital	.020	.022	.019	.022	.026	.033	.037	.039
MOS Memory	.006	.009	.006	.006	.007	.008	.010	.010
MOS Microcomponents	.009	.008	.009	.011	.014	.017	.019	.021
MOS Logic	.005	.004	.004	.005	.006	.008	.008	.007
Bipolar Digital	.005	.004	.003	.003	.003	.003	.003	.002
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.005	.004	.003	.003	.003	.003	.003	.002
Analog	.035	.036	.035	.038	.040	.044	.050	.052
Discrete	.017	.016	.015	.016	.016	.016	.017	.016
Optoelectronics	.006	.007	.006	.005	.005	.005	.005	.005

Source: Dataquest (August 1991)

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Table 26a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Appliances
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	47,238	50,335	52,069	57,753	62,785	66,694	71,378	76,920	10.9	8.1
Total Semiconductor	3,112	3,425	3,616	4,220	5,026	5,997	6,665	7,164	16.7	14.7
Integrated Circuits	2,262	2,617	2,726	3,236	3,949	4,844	5,393	5,854	18.7	16.5
MOS Digital	951	1,169	1,100	1,305	1,745	2,286	2,491	2,685	18.6	19.5
MOS Memory	409	573	413	457	629	800	915	965	10.7	18.5
MOS Microcomponents	323	372	445	551	709	959	1,019	1,159	23.8	21.1
MOS Logic	219	224	242	297	407	527	557	561	22.7	18.3
Bipolar Digital	87	85	85	92	101	103	96	90	8.2	1.1
Bipolar Memory	0	0	0	0	0	0	0	0	0	0
Bipolar Logic	87	85	85	92	101	103	96	90	8.2	1.1
Analog	1,224	1,363	1,541	1,839	2,103	2,455	2,806	3,079	19.3	14.8
Discrete	771	714	805	889	974	1,043	1,157	1,191	10.4	8.1
Optoelectronics	79	94	85	95	103	110	115	119	11.8	7.0

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 26b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Appliances
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.066	.068	.069	.073	.080	.090	.093	.093
Integrated Circuits	.048	.052	.052	.056	.063	.073	.076	.076
MOS Digital	.020	.023	.021	.023	.028	.034	.035	.035
MOS Memory	.009	.011	.008	.008	.010	.012	.013	.013
MOS Microcomponents	.007	.007	.009	.010	.011	.014	.014	.015
MOS Logic	.005	.004	.005	.005	.006	.008	.008	.007
Bipolar Digital	.002	.002	.002	.002	.002	.002	.001	.001
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.002	.002	.002	.002	.002	.002	.001	.001
Analog	.026	.027	.030	.032	.033	.037	.039	.040
Discrete	.016	.014	.015	.015	.016	.016	.016	.015
Optoelectronics	.002	.002	.002	.002	.002	.002	.002	.002

Source: Dataquest (August 1991)

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Table 27a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Other Consumer
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	5,001	5,151	5,355	5,734	6,255	6,532	6,791	7,288	7.1	6.4
Total Semiconductor	642	683	732	829	976	1,168	1,322	1,438	13.3	14.5
Integrated Circuits	389	439	452	528	654	826	964	1,062	16.8	18.6
MOS Digital	164	209	185	214	279	375	430	472	15.7	20.6
MOS Memory	75	119	75	83	110	145	172	183	10.7	19.5
MOS Microcomponents	57	61	74	89	111	151	169	194	20.3	21.3
MOS Logic	32	29	36	42	58	79	89	95	16.7	21.4
Bipolar Digital	23	21	21	20	17	15	13	11	-4.8	-12.1
Bipolar Memory	2	2	1	1	1	1	1	1	0	0
Bipolar Logic	21	19	20	19	16	14	12	10	-5.0	-12.9
Analog	202	209	246	294	358	436	521	579	19.5	18.7
Discrete	206	182	215	232	246	263	273	282	7.9	5.6
Optoelectronics	47	62	65	69	76	79	85	94	6.2	7.7

Note: Some columns do not add to totals shown because of rounding.
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Table 27b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Other Consumer
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.128	.133	.137	.145	.156	.179	.195	.197
Integrated Circuits	.078	.085	.084	.092	.105	.126	.142	.146
MOS Digital	.033	.041	.035	.037	.045	.057	.063	.065
MOS Memory	.015	.023	.014	.014	.018	.022	.025	.025
MOS Microcomponents	.011	.012	.014	.016	.018	.023	.025	.027
MOS Logic	.006	.006	.007	.007	.009	.012	.013	.013
Bipolar Digital	.005	.004	.004	.003	.003	.002	.002	.002
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.004	.004	.004	.003	.003	.002	.002	.001
Analog	.040	.041	.046	.051	.057	.067	.077	.079
Discrete	.041	.035	.040	.040	.039	.040	.040	.039
Optoelectronics	.009	.012	.012	.012	.012	.012	.013	.013

Source: Dataquest (August 1991)

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Table 28a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Military/Aerospace
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	84,604	87,213	87,620	83,698	88,195	91,923	95,446	99,703	-4.5	2.6
Total Semiconductor	2,769	2,859	2,846	2,863	3,077	3,291	3,515	3,768	0.6	5.8
Integrated Circuits	2,189	2,296	2,304	2,324	2,495	2,673	2,868	3,090	0.9	6.0
MOS Digital	1,036	1,191	1,208	1,262	1,389	1,553	1,724	1,908	4.5	9.6
MOS Memory	383	452	411	427	467	522	586	649	3.9	9.6
MOS Microcomponents	247	270	288	304	338	385	428	476	5.6	10.6
MOS Logic	406	469	509	531	584	646	710	783	4.3	9.0
Bipolar Digital	574	519	472	453	454	427	404	389	-4.0	-3.8
Bipolar Memory	96	94	69	64	64	58	54	54	-7.2	-4.8
Bipolar Logic	478	425	403	389	390	369	350	335	-3.5	-3.6
Analog	579	586	624	609	652	693	740	793	-2.4	4.9
Discrete	473	460	443	438	467	489	508	537	-1.1	3.9
Optoelectronics	107	103	99	101	115	129	139	141	2.0	7.3

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 28b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Military/Aerospace
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.033	.033	.032	.034	.035	.036	.037	.038
Integrated Circuits	.026	.026	.026	.028	.028	.029	.030	.031
MOS Digital	.012	.014	.014	.015	.016	.017	.018	.019
MOS Memory	.005	.005	.005	.005	.005	.006	.006	.007
MOS Microcomponents	.003	.003	.003	.004	.004	.004	.004	.005
MOS Logic	.005	.005	.006	.006	.007	.007	.007	.008
Bipolar Digital	.007	.006	.005	.005	.005	.005	.004	.004
Bipolar Memory	.001	.001	.001	.001	.001	.001	.001	.001
Bipolar Logic	.006	.005	.005	.005	.004	.004	.004	.003
Analog	.007	.007	.007	.007	.007	.008	.008	.008
Discrete	.006	.005	.005	.005	.005	.005	.005	.005
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 29a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Transportation
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	13,196	14,352	15,624	16,795	18,916	21,290	24,000	26,481	7.5	11.1
Total Semiconductor	2,389	2,570	2,794	2,979	3,460	3,963	4,456	4,817	6.6	11.5
Integrated Circuits	1,847	1,943	2,101	2,209	2,586	2,955	3,335	3,624	5.1	11.5
MOS Digital	1,395	1,461	1,578	1,655	1,918	2,166	2,439	2,656	4.9	11.0
MOS Memory	149	151	154	159	185	207	235	253	3.2	10.4
MOS Microcomponents	524	523	559	563	629	687	773	839	0.7	8.5
MOS Logic	722	787	865	933	1,104	1,272	1,431	1,564	7.9	12.6
Bipolar Digital	27	34	41	49	61	68	77	69	19.5	11.0
Bipolar Memory	6	6	5	4	3	2	2	1	-20.0	-27.5
Bipolar Logic	21	28	36	45	58	66	75	68	25.0	13.6
Analog	425	448	482	505	607	721	819	899	4.8	13.3
Discrete	415	491	540	601	686	805	905	963	11.3	12.3
Optoelectronics	127	136	153	169	188	203	216	230	10.5	8.5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 29b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Transportation
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.181	.179	.179	.177	.183	.186	.186	.182
Integrated Circuits	.140	.135	.134	.132	.137	.139	.139	.137
MOS Digital	.106	.102	.101	.099	.101	.102	.102	.100
MOS Memory	.011	.011	.010	.009	.010	.010	.010	.010
MOS Microcomponents	.040	.036	.036	.034	.033	.032	.032	.032
MOS Logic	.055	.055	.055	.056	.058	.060	.060	.059
Bipolar Digital	.002	.002	.003	.003	.003	.003	.003	.003
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.002	.002	.002	.003	.003	.003	.003	.003
Analog	.032	.031	.031	.030	.032	.034	.034	.034
Discrete	.031	.034	.035	.036	.036	.038	.038	.036
Optoelectronics	.010	.009	.010	.010	.010	.010	.009	.009

Source: Dataquest (August 1991)

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Table 30a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Data Processing
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	73,428	78,717	82,851	86,968	93,584	100,146	106,665	113,558	5.0	6.5
Total Semiconductor	8,574	10,185	9,561	10,405	11,864	13,706	14,866	15,496	8.8	10.1
Integrated Circuits	8,295	9,891	9,278	10,105	11,549	13,363	14,507	15,140	8.9	10.3
MOS Digital	6,691	8,392	7,790	8,571	10,018	11,730	12,920	13,590	10.0	11.8
MOS Memory	3,422	4,931	3,710	4,001	4,671	5,548	6,494	6,975	7.8	13.5
MOS Microcomponents	1,778	2,013	2,507	2,824	3,344	3,853	4,030	4,187	12.6	10.8
MOS Logic	1,491	1,448	1,573	1,746	2,003	2,328	2,396	2,429	11.0	9.1
Bipolar Digital	1,132	997	979	983	960	1,028	953	878	0.4	-2.2
Bipolar Memory	113	95	90	79	72	74	65	55	-11.9	-9.3
Bipolar Logic	1,020	902	889	904	888	955	888	823	1.6	-1.5
Analog	472	502	509	551	571	606	634	673	8.2	5.7
Discrete	182	193	191	201	205	221	228	222	5.4	3.1
Optoelectronics	96	101	93	100	111	121	131	133	7.3	7.5

Note: Some columns do not add to totals shown because of rounding.
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Table 30b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Data Processing
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.117	.129	.115	.120	.127	.137	.139	.136
Integrated Circuits	.113	.126	.112	.116	.123	.133	.136	.133
MOS Digital	.091	.107	.094	.099	.107	.117	.121	.120
MOS Memory	.047	.063	.045	.046	.050	.055	.061	.061
MOS Microcomponents	.024	.026	.030	.032	.036	.038	.038	.037
MOS Logic	.020	.018	.019	.020	.021	.023	.022	.021
Bipolar Digital	.015	.013	.012	.011	.010	.010	.009	.008
Bipolar Memory	.002	.001	.001	.001	.001	.001	.001	0
Bipolar Logic	.014	.011	.011	.010	.009	.010	.008	.007
Analog	.006	.006	.006	.006	.006	.006	.006	.006
Discrete	.002	.002	.002	.002	.002	.002	.002	.002
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 31a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Computers
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	49,427	52,992	55,750	57,840	61,824	65,373	69,247	72,884	3.7	5.5
Total Semiconductor	6,292	7,591	7,016	7,539	8,562	9,777	10,457	10,631	7.5	8.7
Integrated Circuits	6,122	7,409	6,842	7,360	8,378	9,582	10,255	10,435	7.6	8.8
MOS Digital	5,054	6,461	5,901	6,404	7,424	8,554	9,278	9,519	8.5	10.0
MOS Memory	2,790	4,036	3,002	3,162	3,631	4,206	4,837	5,062	5.3	11.0
MOS Microcomponents	1,236	1,418	1,815	2,041	2,423	2,756	2,821	2,839	12.5	9.4
MOS Logic	1,029	1,007	1,084	1,201	1,371	1,592	1,620	1,618	10.8	8.3
Bipolar Digital	1,014	888	874	882	865	931	863	798	0.9	-1.8
Bipolar Memory	97	83	79	69	63	65	57	49	-12.2	-9.2
Bipolar Logic	917	805	795	813	802	866	806	750	2.2	-1.2
Analog	54	60	68	73	89	98	114	118	8.6	11.7
Discrete	114	123	122	127	129	138	143	138	3.7	2.5
Optoelectronics	56	59	52	53	55	57	59	58	1.7	2.3

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 31b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Computers
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.127	.143	.126	.130	.138	.150	.151	.146
Integrated Circuits	.124	.140	.123	.127	.136	.147	.148	.143
MOS Digital	.102	.122	.106	.111	.120	.131	.134	.131
MOS Memory	.056	.076	.054	.055	.059	.064	.070	.069
MOS Microcomponents	.025	.027	.033	.035	.039	.042	.041	.039
MOS Logic	.021	.019	.019	.021	.022	.024	.023	.022
Bipolar Digital	.021	.017	.016	.015	.014	.014	.012	.011
Bipolar Memory	.002	.002	.001	.001	.001	.001	.001	.001
Bipolar Logic	.019	.015	.014	.014	.013	.013	.012	.010
Analog	.001	.001	.001	.001	.001	.001	.002	.002
Discrete	.002	.002	.002	.002	.002	.002	.002	.002
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 32a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Data Storage
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	6,189	6,677	7,015	7,325	7,235	7,602	8,048	8,750	4.4	4.5
Total Semiconductor	923	951	948	965	910	924	906	959	1.8	0.2
Integrated Circuits	894	922	921	939	886	901	884	936	1.9	0.3
MOS Digital	539	547	552	559	535	549	541	573	1.2	0.7
MOS Memory	82	102	84	97	100	118	136	155	15.9	13.1
MOS Microcomponents	229	240	258	251	230	227	219	232	-2.8	-2.1
MOS Logic	228	205	211	211	205	204	186	186	0.2	-2.4
Bipolar Digital	31	31	29	24	19	18	15	14	-15.3	-14.0
Bipolar Memory	4	3	3	3	3	2	2	2	-9.4	-9.0
Bipolar Logic	27	27	26	21	17	15	13	12	-16.1	-14.7
Analog	325	344	340	356	332	335	328	350	4.6	0.6
Discrete	22	22	21	21	18	18	17	17	-0.5	-3.6
Optoelectronics	7	7	6	6	5	5	5	5	-1.7	-3.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 32b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Data Storage
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.149	.142	.135	.132	.126	.122	.113	.110
Integrated Circuits	.144	.138	.131	.128	.122	.119	.110	.107
MOS Digital	.087	.082	.079	.076	.074	.072	.067	.065
MOS Memory	.013	.015	.012	.013	.014	.016	.017	.018
MOS Microcomponents	.037	.036	.037	.034	.032	.030	.027	.026
MOS Logic	.037	.031	.030	.029	.028	.027	.023	.021
Bipolar Digital	.005	.005	.004	.003	.003	.002	.002	.002
Bipolar Memory	.001	0	0	0	0	0	0	0
Bipolar Logic	.004	.004	.004	.003	.002	.002	.002	.001
Analog	.052	.052	.048	.049	.046	.044	.041	.040
Discrete	.003	.003	.003	.003	.003	.002	.002	.002
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 33a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Terminals
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	2,312	2,179	2,082	2,355	2,741	3,025	3,045	3,117	13.1	8.4
Total Semiconductor	212	227	198	239	296	350	377	391	20.6	14.6
Integrated Circuits	199	214	187	226	282	335	362	377	21.0	15.1
MOS Digital	137	157	130	156	197	235	256	266	20.1	15.4
MOS Memory	65	87	54	63	78	95	107	113	15.8	15.7
MOS Microcomponents	44	45	50	61	78	93	101	105	23.6	16.3
MOS Logic	28	25	26	32	40	48	49	48	22.2	13.1
Bipolar Digital	13	10	9	11	11	12	11	10	11.7	0.8
Bipolar Memory	2	1	1	1	1	1	1	1	9.1	0
Bipolar Logic	12	9	8	9	10	11	10	9	12.0	0.9
Analog	48	48	47	59	75	87	95	101	25.6	16.4
Discrete	11	10	9	11	11	12	12	11	14.0	4.2
Optoelectronics	3	2	2	2	3	3	3	3	10.0	5.4

Note: Some columns do not add to totals shown because of rounding.
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Table 33b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Terminals
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.092	.104	.095	.101	.108	.116	.124	.125
Integrated Circuits	.086	.098	.090	.096	.103	.111	.119	.121
MOS Digital	.059	.072	.062	.066	.072	.078	.084	.085
MOS Memory	.028	.040	.026	.027	.028	.031	.035	.036
MOS Microcomponents	.019	.021	.024	.026	.028	.031	.033	.034
MOS Logic	.012	.011	.013	.014	.015	.016	.016	.015
Bipolar Digital	.006	.005	.005	.004	.004	.004	.004	.003
Bipolar Memory	.001	.001	.001	.001	0	0	0	0
Bipolar Logic	.005	.004	.004	.004	.004	.004	.003	.003
Analog	.021	.022	.023	.025	.027	.029	.031	.032
Discrete	.005	.005	.004	.005	.004	.004	.004	.004
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 34a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Input/Output
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	10,393	11,845	13,209	14,684	16,607	18,593	20,433	22,561	11.2	11.3
Total Semiconductor	809	1,060	1,074	1,319	1,692	2,177	2,599	2,962	22.8	22.5
Integrated Circuits	761	1,006	1,017	1,252	1,612	2,084	2,495	2,856	23.1	22.9
MOS Digital	674	915	921	1,147	1,498	1,957	2,362	2,722	24.6	24.2
MOS Memory	354	543	442	546	705	938	1,189	1,403	23.5	26.0
MOS Microcomponents	173	212	279	355	472	611	712	822	27.3	24.1
MOS Logic	147	159	200	246	321	408	461	498	23.2	20.0
Bipolar Digital	53	52	53	53	52	55	53	46	0.2	-2.6
Bipolar Memory	7	5	5	4	4	4	3	3	-12.2	-11.9
Bipolar Logic	46	47	48	48	49	51	50	44	1.5	-1.8
Analog	34	39	44	52	62	72	81	88	18.2	14.8
Discrete	24	26	28	33	35	41	43	43	16.0	8.9
Optoelectronics	25	28	29	35	44	53	61	64	20.6	17.4

Note: Some columns do not add to totals shown because of rounding.
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Table 34b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Input/Output
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.078	.089	.081	.090	.102	.117	.127	.131
Integrated Circuits	.073	.085	.077	.085	.097	.112	.122	.127
MOS Digital	.065	.077	.070	.078	.090	.105	.116	.121
MOS Memory	.034	.046	.033	.037	.042	.050	.058	.062
MOS Microcomponents	.017	.018	.021	.024	.028	.033	.035	.036
MOS Logic	.014	.013	.015	.017	.019	.022	.023	.022
Bipolar Digital	.005	.004	.004	.004	.003	.003	.003	.002
Bipolar Memory	.001	0	0	0	0	0	0	0
Bipolar Logic	.004	.004	.004	.003	.003	.003	.002	.002
Analog	.003	.003	.003	.004	.004	.004	.004	.004
Discrete	.002	.002	.002	.002	.002	.002	.002	.002
Optoelectronics	.002	.002	.002	.002	.003	.003	.003	.003

Source: Dataquest (August 1991)

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Table 35a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Dedicated
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	5,107	5,024	4,795	4,764	5,177	5,553	5,892	6,246	-0.6	5.4
Total Semiconductor	337	357	326	343	406	478	527	553	5.3	11.1
Integrated Circuits	320	341	311	328	391	462	510	536	5.6	11.5
MOS Digital	287	314	286	304	365	435	483	510	6.3	12.2
MOS Memory	131	164	128	133	158	192	224	243	4.2	13.6
MOS Microcomponents	97	99	106	115	141	167	179	189	9.1	12.3
MOS Logic	58	51	53	56	66	77	80	78	5.5	8.3
Bipolar Digital	22	16	14	13	13	13	12	10	-7.1	-6.3
Bipolar Memory	3	2	2	2	1	1	1	1	-16.7	-15.0
Bipolar Logic	18	14	12	12	11	12	11	9	-5.7	-5.2
Analog	11	11	11	11	13	14	16	16	4.7	8.9
Discrete	12	11	11	11	11	12	13	13	1.0	3.7
Optoelectronics	6	5	4	4	4	4	4	4	-2.3	-2.9

Note: Some columns do not add to totals shown because of rounding.
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Table 35b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Dedicated
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.066	.071	.068	.072	.078	.086	.089	.088
Integrated Circuits	.063	.068	.065	.069	.075	.083	.087	.086
MOS Digital	.056	.062	.060	.064	.071	.078	.082	.082
MOS Memory	.026	.033	.027	.028	.031	.035	.038	.039
MOS Microcomponents	.019	.020	.022	.024	.027	.030	.030	.030
MOS Logic	.011	.010	.011	.012	.013	.014	.014	.013
Bipolar Digital	.004	.003	.003	.003	.002	.002	.002	.002
Bipolar Memory	.001	0	0	0	0	0	0	0
Bipolar Logic	.004	.003	.003	.002	.002	.002	.002	.002
Analog	.002	.002	.002	.002	.002	.003	.003	.003
Discrete	.002	.002	.002	.002	.002	.002	.002	.002
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 36a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Communications
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	25,409	28,227	30,188	32,520	35,408	37,972	40,184	42,614	7.7	7.1
Total Semiconductor	1,608	1,805	1,822	2,006	2,352	2,861	3,062	3,060	10.1	10.9
Integrated Circuits	1,312	1,511	1,516	1,686	2,024	2,496	2,691	2,723	11.2	12.4
MOS Digital	767	918	857	984	1,220	1,561	1,669	1,617	14.7	13.5
MOS Memory	276	460	310	331	389	520	576	559	7.1	12.6
MOS Microcomponents	208	220	269	323	417	520	569	590	20.1	17.0
MOS Logic	282	238	279	330	414	522	524	468	17.9	10.9
Bipolar Digital	150	103	100	95	88	94	77	62	-4.4	-9.1
Bipolar Memory	13	9	8	6	6	5	4	3	-19.2	-16.3
Bipolar Logic	137	94	92	89	82	88	72	59	-3.2	-8.6
Analog	395	491	559	608	716	841	945	1,044	8.7	13.3
Discrete	239	240	253	268	273	309	315	287	6.0	2.5
Optoelectronics	58	54	53	52	55	56	56	51	-2.1	-0.9

Note: Some columns do not add to totals shown because of rounding.
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Table 36b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Communications
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.063	.064	.060	.062	.066	.075	.076	.072
Integrated Circuits	.052	.054	.050	.052	.057	.066	.067	.064
MOS Digital	.030	.033	.028	.030	.034	.041	.042	.038
MOS Memory	.011	.016	.010	.010	.011	.014	.014	.013
MOS Microcomponents	.008	.008	.009	.010	.012	.014	.014	.014
MOS Logic	.011	.008	.009	.010	.012	.014	.013	.011
Bipolar Digital	.006	.004	.003	.003	.002	.002	.002	.001
Bipolar Memory	.001	0	0	0	0	0	0	0
Bipolar Logic	.005	.003	.003	.003	.002	.002	.002	.001
Analog	.016	.017	.019	.019	.020	.022	.024	.025
Discrete	.009	.008	.008	.008	.008	.008	.008	.007
Optoelectronics	.002	.002	.002	.002	.002	.001	.001	.001

Source: Dataquest (August 1991)

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Table 37a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Premise Telecom
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	10,782	12,891	14,350	15,894	17,631	18,955	19,820	20,938	10.8	7.8
Total Semiconductor	867	1,019	1,060	1,172	1,383	1,673	1,830	1,847	10.6	11.8
Integrated Circuits	719	867	895	999	1,206	1,477	1,631	1,666	11.6	13.2
MOS Digital	432	543	523	606	756	955	1,061	1,045	15.7	14.8
MOS Memory	161	276	192	207	243	306	360	350	7.4	12.7
MOS Microcomponents	128	141	176	215	281	353	401	426	22.0	19.3
MOS Logic	143	126	155	184	233	296	300	270	18.8	11.7
Bipolar Digital	75	53	54	51	47	50	41	34	-5.4	-9.1
Bipolar Memory	3	2	2	2	1	1	1	1	-20.0	-16.7
Bipolar Logic	72	51	52	50	46	49	40	33	-4.8	-8.9
Analog	212	271	318	343	403	472	529	587	7.8	13.1
Discrete	125	129	140	149	151	171	174	157	6.1	2.3
Optoelectronics	23	22	24	24	25	26	26	24	-1.3	0.1

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 37b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Premise Telecom
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.080	.079	.074	.074	.078	.088	.092	.088
Integrated Circuits	.067	.067	.062	.063	.068	.078	.082	.080
MOS Digital	.040	.042	.036	.038	.043	.050	.054	.050
MOS Memory	.015	.021	.013	.013	.014	.016	.018	.017
MOS Microcomponents	.012	.011	.012	.013	.016	.019	.020	.020
MOS Logic	.013	.010	.011	.012	.013	.016	.015	.013
Bipolar Digital	.007	.004	.004	.003	.003	.003	.002	.002
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.007	.004	.004	.003	.003	.003	.002	.002
Analog	.020	.021	.022	.022	.023	.025	.027	.028
Discrete	.012	.010	.010	.009	.009	.009	.009	.008
Optoelectronics	.002	.002	.002	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 38a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Public Telecom
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	6,740	7,020	7,211	7,595	8,264	8,947	9,705	10,392	5.3	7.6
Total Semiconductor	335	357	342	370	425	503	528	512	8.2	8.4
Integrated Circuits	262	287	272	298	353	423	448	441	9.6	10.1
MOS Digital	166	186	166	186	227	279	293	273	12.6	10.5
MOS Memory	56	89	56	60	69	86	101	97	6.7	11.4
MOS Microcomponents	40	40	46	53	66	79	80	78	15.0	11.0
MOS Logic	70	57	63	73	91	114	112	99	16.1	9.3
Bipolar Digital	22	14	13	12	11	11	9	7	-5.5	-11.0
Bipolar Memory	3	2	2	1	1	1	1	1	-23.5	-18.8
Bipolar Logic	19	12	11	11	10	10	8	7	-2.7	-10.0
Analog	74	87	94	100	115	133	147	161	6.3	11.4
Discrete	55	53	53	56	56	63	63	57	4.9	1.6
Optoelectronics	19	17	17	16	17	17	16	14	-3.6	-3.0

Note: Some columns do not add to totals shown because of rounding.
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Table 38b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Public Telecom
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.050	.051	.047	.049	.051	.056	.054	.049
Integrated Circuits	.039	.041	.038	.039	.043	.047	.046	.042
MOS Digital	.025	.026	.023	.025	.027	.031	.030	.026
MOS Memory	.008	.013	.008	.008	.008	.010	.010	.009
MOS Microcomponents	.006	.006	.006	.007	.008	.009	.008	.007
MOS Logic	.010	.008	.009	.010	.011	.013	.012	.009
Bipolar Digital	.003	.002	.002	.002	.001	.001	.001	.001
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.003	.002	.002	.001	.001	.001	.001	.001
Analog	.011	.012	.013	.013	.014	.015	.015	.015
Discrete	.008	.008	.007	.007	.007	.007	.007	.006
Optoelectronics	.003	.002	.002	.002	.002	.002	.002	.001

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Table 39a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Mobile Communications
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	2,305	2,576	2,724	2,908	3,138	3,431	3,788	4,123	6.8	8.6
Total Semiconductor	119	131	130	147	174	211	232	236	12.8	12.6
Integrated Circuits	96	108	107	122	147	181	200	206	14.0	14.1
MOS Digital	31	37	30	33	42	55	58	56	11.5	13.5
MOS Memory	12	19	11	12	15	19	22	22	4.4	14.0
MOS Microcomponents	8	9	9	11	14	18	18	18	15.2	14.5
MOS Logic	11	9	9	11	14	18	18	16	16.7	11.8
Bipolar Digital	16	11	10	10	10	11	9	8	0	-6.3
Bipolar Memory	2	1	1	1	1	1	1	1	-16.7	-12.9
Bipolar Logic	14	10	9	9	10	10	8	7	2.2	-5.6
Analog	48	60	67	78	95	115	133	143	17.2	16.5
Discrete	18	18	19	20	21	24	26	24	8.6	5.1
Optoelectronics	5	5	5	5	5	6	6	5	2.1	2.4

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 39b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Mobile Communications
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.051	.051	.048	.050	.055	.061	.061	.057
Integrated Circuits	.041	.042	.039	.042	.047	.053	.053	.050
MOS Digital	.014	.014	.011	.011	.013	.016	.015	.013
MOS Memory	.005	.007	.004	.004	.005	.006	.006	.005
MOS Microcomponents	.004	.003	.003	.004	.004	.005	.005	.004
MOS Logic	.005	.003	.003	.004	.004	.005	.005	.004
Bipolar Digital	.007	.004	.004	.004	.003	.003	.002	.002
Bipolar Memory	.001	.001	0	0	0	0	0	0
Bipolar Logic	.006	.004	.003	.003	.003	.003	.002	.002
Analog	.021	.023	.024	.027	.030	.034	.035	.035
Discrete	.008	.007	.007	.007	.007	.007	.007	.006
Optoelectronics	.002	.002	.002	.002	.002	.002	.002	.001

Source: Dataquest (August 1991)

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Table 40a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company: All
Product: Broadcast & Studio
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	1,784	1,905	1,973	2,031	2,114	2,207	2,286	2,385	2.9	3.9
Total Semiconductor	77	79	74	79	89	103	106	100	5.9	6.2
Integrated Circuits	63	66	61	66	76	89	92	89	7.3	7.6
MOS Digital	36	40	35	39	47	57	58	53	11.0	8.6
MOS Memory	13	20	13	13	15	19	21	20	3.1	9.4
MOS Microcomponents	8	8	10	11	14	16	16	15	16.8	9.3
MOS Logic	15	12	13	15	18	22	21	18	14.6	7.2
Bipolar Digital	11	7	6	6	5	6	5	4	-6.3	-11.1
Bipolar Memory	2	1	1	1	1	1	1	0	-18.2	-18.3
Bipolar Logic	9	6	5	5	5	5	4	3	-3.8	-9.8
Analog	16	18	20	21	24	27	29	32	5.1	10.0
Discrete	11	10	11	11	11	11	11	10	1.0	-1.2
Optoelectronics	3	3	3	2	2	2	2	2	-8.0	-6.4

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 40b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Broadcast & Studio
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.043	.041	.038	.039	.042	.047	.046	.042
Integrated Circuits	.035	.034	.031	.032	.036	.040	.040	.037
MOS Digital	.020	.021	.018	.019	.022	.026	.026	.022
MOS Memory	.007	.011	.007	.007	.007	.008	.009	.008
MOS Microcomponents	.005	.004	.005	.005	.006	.007	.007	.006
MOS Logic	.008	.006	.007	.007	.009	.010	.009	.008
Bipolar Digital	.006	.004	.003	.003	.003	.002	.002	.001
Bipolar Memory	.001	.001	.001	0	0	0	0	0
Bipolar Logic	.005	.003	.003	.002	.002	.002	.002	.001
Analog	.009	.010	.010	.010	.011	.012	.013	.013
Discrete	.006	.005	.005	.005	.005	.005	.005	.004
Optoelectronics	.002	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 41a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Other Communications
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	3,798	3,835	3,930	4,092	4,261	4,432	4,585	4,776	4.1	4.0
Total Semiconductor	211	220	216	239	281	371	366	365	10.7	11.1
Integrated Circuits	172	184	180	201	242	326	319	322	11.6	12.3
MOS Digital	101	112	104	119	148	217	200	190	15.2	12.9
MOS Memory	35	55	37	40	47	90	72	71	7.9	14.1
MOS Microcomponents	23	22	28	34	43	54	55	54	19.6	14.0
MOS Logic	43	35	39	46	58	73	73	66	18.7	11.0
Bipolar Digital	26	18	16	16	15	16	13	10	-2.5	-8.7
Bipolar Memory	3	2	2	2	1	1	1	1	-16.7	-15.0
Bipolar Logic	23	15	14	14	13	14	12	10	-0.7	-8.0
Analog	45	54	61	66	79	94	107	121	9.4	14.8
Discrete	30	29	30	33	34	39	41	38	7.6	4.6
Optoelectronics	8	7	5	5	6	6	6	5	-1.9	0

Note: Some columns do not add to totals shown because of rounding.
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Table 41b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Other Communications
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.055	.057	.055	.058	.066	.084	.080	.076
Integrated Circuits	.045	.048	.046	.049	.057	.074	.070	.067
MOS Digital	.027	.029	.026	.029	.035	.049	.044	.040
MOS Memory	.009	.014	.009	.010	.011	.020	.016	.015
MOS Microcomponents	.006	.006	.007	.008	.010	.012	.012	.011
MOS Logic	.011	.009	.010	.011	.014	.016	.016	.014
Bipolar Digital	.007	.005	.004	.004	.003	.004	.003	.002
Bipolar Memory	.001	.001	0	0	0	0	0	0
Bipolar Logic	.006	.004	.004	.003	.003	.003	.003	.002
Analog	.012	.014	.015	.016	.019	.021	.023	.025
Discrete	.008	.008	.008	.008	.008	.009	.009	.008
Optoelectronics	.002	.002	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 42a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Industrial
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	30,385	32,386	33,690	35,233	37,834	40,704	43,254	46,062	4.6	6.5
Total Semiconductor	1,682	1,741	1,807	2,036	2,380	2,919	3,189	3,227	12.6	12.3
Integrated Circuits	1,059	1,146	1,223	1,417	1,743	2,200	2,450	2,550	15.9	15.8
MOS Digital	484	561	588	709	941	1,259	1,426	1,489	20.7	20.4
MOS Memory	103	183	130	145	185	251	320	349	12.1	21.9
MOS Microcomponents	184	192	222	275	369	484	545	586	23.9	21.4
MOS Logic	197	185	236	289	388	523	562	554	22.3	18.6
Bipolar Digital	263	181	172	167	153	163	133	108	-2.7	-8.9
Bipolar Memory	30	21	18	15	13	13	11	8	-13.6	-14.9
Bipolar Logic	233	160	154	152	140	150	122	100	-1.5	-8.3
Analog	312	404	463	541	650	778	890	953	16.8	15.5
Discrete	537	517	508	543	557	637	656	600	6.8	3.4
Optoelectronics	86	78	76	76	80	82	83	77	-1.2	0.2

Note: Some columns do not add to totals shown because of rounding.
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Table 42b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Industrial
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.055	.054	.054	.058	.063	.072	.074	.070
Integrated Circuits	.035	.035	.036	.040	.046	.054	.057	.055
MOS Digital	.016	.017	.017	.020	.025	.031	.033	.032
MOS Memory	.003	.006	.004	.004	.005	.006	.007	.008
MOS Microcomponents	.006	.006	.007	.008	.010	.012	.013	.013
MOS Logic	.006	.006	.007	.008	.010	.013	.013	.012
Bipolar Digital	.009	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	.001	0	0	0	0	0
Bipolar Logic	.008	.005	.005	.004	.004	.004	.003	.002
Analog	.010	.012	.014	.015	.017	.019	.021	.021
Discrete	.018	.016	.015	.015	.015	.016	.015	.013
Optoelectronics	.003	.002	.002	.002	.002	.002	.002	.002

Source: Dataquest (August 1991)

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Table 43a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Security & Energy Management
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	3,333	3,490	3,691	3,826	3,987	4,203	4,436	4,666	3.7	4.8
Total Semiconductor	137	137	145	161	189	234	253	257	11.2	12.2
Integrated Circuits	99	103	114	131	160	203	224	233	14.9	15.4
MOS Digital	36	40	46	57	79	109	123	130	23.3	22.9
MOS Memory	6	10	7	7	8	11	13	13	6.1	15.0
MOS Microcomponents	8	9	12	15	23	32	38	44	29.7	30.0
MOS Logic	22	21	28	35	48	66	72	73	24.7	21.0
Bipolar Digital	30	21	20	19	17	18	14	12	-5.1	-10.3
Bipolar Memory	4	3	2	2	2	2	1	1	-20.8	-16.1
Bipolar Logic	26	18	17	17	15	16	13	11	-2.9	-9.6
Analog	33	42	48	55	64	77	87	92	14.9	14.0
Discrete	34	30	28	27	25	27	25	21	-2.2	-5.3
Optoelectronics	4	4	4	3	4	4	4	3	-2.9	-1.2

Note: Some columns do not add to totals shown because of rounding.
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Table 43b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Security & Energy Management
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.041	.039	.039	.042	.047	.056	.057	.055
Integrated Circuits	.030	.029	.031	.034	.040	.048	.050	.050
MOS Digital	.011	.011	.013	.015	.020	.026	.028	.028
MOS Memory	.002	.003	.002	.002	.002	.003	.003	.003
MOS Microcomponents	.003	.003	.003	.004	.006	.008	.009	.009
MOS Logic	.007	.006	.008	.009	.012	.016	.016	.016
Bipolar Digital	.009	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	.001	0	0	0	0	0
Bipolar Logic	.008	.005	.005	.004	.004	.004	.003	.002
Analog	.010	.012	.013	.014	.016	.018	.019	.020
Discrete	.010	.009	.007	.007	.006	.006	.006	.005
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 44a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Manufacturing Systems
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	10,340	11,056	11,397	11,958	12,977	14,098	14,953	15,780	4.9	6.7
Total Semiconductor	664	676	690	780	916	1,136	1,247	1,264	13.0	12.9
Integrated Circuits	367	399	424	506	641	834	946	996	19.4	18.6
MOS Digital	210	251	269	338	458	626	729	778	25.8	23.7
MOS Memory	43	79	58	68	89	124	164	184	16.3	25.8
MOS Microcomponents	99	104	121	155	206	272	309	332	28.2	22.4
MOS Logic	68	67	90	116	163	229	256	263	28.6	23.9
Bipolar Digital	89	61	58	56	52	56	45	36	-2.8	-8.9
Bipolar Memory	10	7	6	5	4	4	3	3	-18.6	-15.8
Bipolar Logic	79	54	52	52	48	51	42	34	-1.0	-8.2
Analog	68	86	97	111	131	153	172	181	15.0	13.3
Discrete	251	234	225	232	231	256	255	226	3.5	0.2
Optoelectronics	47	43	42	42	44	45	46	42	-0.7	0

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 44b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Manufacturing Systems
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.064	.061	.061	.065	.071	.081	.083	.080
Integrated Circuits	.035	.036	.037	.042	.049	.059	.063	.063
MOS Digital	.020	.023	.024	.028	.035	.044	.049	.049
MOS Memory	.004	.007	.005	.006	.007	.009	.011	.012
MOS Microcomponents	.010	.009	.011	.013	.016	.019	.021	.021
MOS Logic	.007	.006	.008	.010	.013	.016	.017	.017
Bipolar Digital	.009	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	.001	0	0	0	0	0
Bipolar Logic	.008	.005	.005	.004	.004	.004	.003	.002
Analog	.007	.008	.009	.009	.010	.011	.011	.011
Discrete	.024	.021	.020	.019	.018	.018	.017	.014
Optoelectronics	.005	.004	.004	.003	.003	.003	.003	.003

Source: Dataquest (August 1991)

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Table 45a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Instrumentation
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	7,346	7,860	8,173	8,577	9,263	9,924	10,604	11,355	4.9	6.8
Total Semiconductor	352	372	386	433	506	615	672	681	12.3	12.1
Integrated Circuits	235	257	269	305	371	458	507	527	13.6	14.4
MOS Digital	101	118	116	131	169	217	238	242	13.5	15.9
MOS Memory	24	43	31	35	45	61	79	86	12.3	22.6
MOS Microcomponents	56	56	61	69	90	112	115	114	13.0	13.2
MOS Logic	21	19	23	27	34	44	45	42	16.4	12.3
Bipolar Digital	63	43	41	40	36	39	32	27	-2.2	-8.4
Bipolar Memory	7	5	4	4	3	4	3	2	2.5	-12.1
Bipolar Logic	56	39	37	36	33	36	30	24	-2.7	-8.0
Analog	72	95	112	134	165	202	237	259	19.4	18.2
Discrete	101	102	103	114	121	142	150	141	10.6	6.4
Optoelectronics	15	14	14	14	15	15	15	14	-0.7	0.3

Note: Some columns do not add to totals shown because of rounding.
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Table 45b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Instrumentation
Region of Production:	Worldwide
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.048	.047	.047	.050	.055	.062	.063	.060
Integrated Circuits	.032	.033	.033	.036	.040	.046	.048	.046
MOS Digital	.014	.015	.014	.015	.018	.022	.022	.021
MOS Memory	.003	.006	.004	.004	.005	.006	.007	.008
MOS Microcomponents	.008	.007	.008	.008	.010	.011	.011	.010
MOS Logic	.003	.002	.003	.003	.004	.004	.004	.004
Bipolar Digital	.009	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	0	0	0	0	0	0
Bipolar Logic	.008	.005	.005	.004	.004	.004	.003	.002
Analog	.010	.012	.014	.016	.018	.020	.022	.023
Discrete	.014	.013	.013	.013	.013	.014	.014	.012
Optoelectronics	.002	.002	.002	.002	.002	.002	.001	.001

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Table 46a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Medical Equipment
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	5,982	6,355	6,680	7,019	7,492	8,059	8,629	9,281	5.1	6.8
Total Semiconductor	280	290	299	333	384	465	502	504	11.4	11.0
Integrated Circuits	198	211	221	249	297	366	400	413	12.9	13.3
MOS Digital	80	90	90	105	134	176	197	205	16.0	17.9
MOS Memory	20	34	23	24	30	39	48	49	8.4	17.0
MOS Microcomponents	9	11	14	18	27	39	51	65	33.6	36.5
MOS Logic	51	45	54	62	78	98	99	91	14.7	11.0
Bipolar Digital	52	36	34	34	31	33	27	22	-2.0	-8.7
Bipolar Memory	6	4	4	3	3	3	2	2	-17.1	-15.6
Bipolar Logic	46	32	31	31	28	31	25	20	-0.3	-8.0
Analog	65	85	97	111	132	157	177	186	15.3	14.0
Discrete	73	71	70	76	78	90	92	84	8.1	3.7
Optoelectronics	9	8	8	8	8	9	9	8	-1.2	-0.5

Note: Some columns do not add to totals shown because of rounding.
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Table 46b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Medical Equipment
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.047	.046	.045	.047	.051	.058	.058	.054
Integrated Circuits	.033	.033	.033	.036	.040	.045	.046	.044
MOS Digital	.013	.014	.013	.015	.018	.022	.023	.022
MOS Memory	.003	.005	.003	.003	.004	.005	.006	.005
MOS Microcomponents	.002	.002	.002	.003	.004	.005	.006	.007
MOS Logic	.009	.007	.008	.009	.010	.012	.011	.010
Bipolar Digital	.009	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	.001	0	0	0	0	0
Bipolar Logic	.008	.005	.005	.004	.004	.004	.003	.002
Analog	.011	.013	.014	.016	.018	.019	.020	.020
Discrete	.012	.011	.010	.011	.010	.011	.011	.009
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 47a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Other Industrial
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	3,384	3,625	3,749	3,853	4,115	4,420	4,632	4,980	2.8	5.8
Total Semiconductor	250	267	288	329	386	470	515	521	14.2	12.6
Integrated Circuits	161	177	196	226	275	338	372	382	15.6	14.3
MOS Digital	58	61	67	78	101	131	139	135	17.1	15.0
MOS Memory	11	17	11	11	13	16	18	17	0.9	8.8
MOS Microcomponents	12	11	15	18	23	30	31	31	20.5	16.5
MOS Logic	35	33	41	49	65	86	90	86	20.3	16.0
Bipolar Digital	29	20	19	18	17	18	15	12	-2.6	-9.0
Bipolar Memory	3	2	2	2	1	1	1	1	-15.8	-15.9
Bipolar Logic	26	18	17	17	15	16	13	11	-1.2	-8.3
Analog	74	96	110	130	157	190	219	236	17.8	16.5
Discrete	78	80	83	94	101	122	133	128	12.9	9.1
Optoelectronics	11	10	9	9	10	10	10	10	-3.2	1.6

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 47b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Other Industrial
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.074	.074	.077	.085	.094	.106	.111	.105
Integrated Circuits	.047	.049	.052	.059	.067	.077	.080	.077
MOS Digital	.017	.017	.018	.020	.024	.030	.030	.027
MOS Memory	.003	.005	.003	.003	.003	.004	.004	.003
MOS Microcomponents	.003	.003	.004	.005	.006	.007	.007	.006
MOS Logic	.010	.009	.011	.013	.016	.019	.019	.017
Bipolar Digital	.009	.006	.005	.005	.004	.004	.003	.002
Bipolar Memory	.001	.001	.001	0	0	0	0	0
Bipolar Logic	.008	.005	.005	.004	.004	.004	.003	.002
Analog	.022	.026	.029	.034	.038	.043	.047	.047
Discrete	.023	.022	.022	.024	.025	.028	.029	.026
Optoelectronics	.003	.003	.003	.002	.002	.002	.002	.002

Source: Dataquest (August 1991)

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Table 48a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Consumer
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	15,454	17,081	17,005	17,396	18,370	19,236	20,145	20,974	2.3	4.3
Total Semiconductor	1,026	1,199	1,202	1,346	1,535	1,811	2,008	2,198	12.0	12.8
Integrated Circuits	762	928	937	1,069	1,239	1,495	1,681	1,863	14.1	14.7
MOS Digital	311	369	348	375	446	560	596	659	7.7	13.6
MOS Memory	135	190	149	154	176	216	240	274	3.0	13.0
MOS Microcomponents	123	134	149	168	201	255	265	293	12.5	14.5
MOS Logic	53	45	50	54	69	88	92	91	7.2	12.7
Bipolar Digital	18	12	9	7	6	4	3	3	-21.7	-21.2
Bipolar Memory	2	3	2	2	1	1	1	1	-23.8	-15.6
Bipolar Logic	16	9	7	6	5	3	2	2	-21.1	-23.2
Analog	433	547	580	687	787	931	1,082	1,202	18.5	15.7
Discrete	246	254	249	262	280	301	311	318	5.1	5.0
Optoelectronics	18	17	16	15	16	16	17	17	-3.2	1.3

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 48b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Consumer
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.066	.070	.071	.077	.084	.094	.100	.105
Integrated Circuits	.049	.054	.055	.061	.067	.078	.083	.089
MOS Digital	.020	.022	.020	.022	.024	.029	.030	.031
MOS Memory	.009	.011	.009	.009	.010	.011	.012	.013
MOS Microcomponents	.008	.008	.009	.010	.011	.013	.013	.014
MOS Logic	.003	.003	.003	.003	.004	.005	.005	.004
Bipolar Digital	.001	.001	.001	0	0	0	0	0
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.001	.001	0	0	0	0	0	0
Analog	.028	.032	.034	.039	.043	.048	.054	.057
Discrete	.016	.015	.015	.015	.015	.016	.015	.015
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 49a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Audio
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	703	697	707	722	736	750	764	778	2.1	1.9
Total Semiconductor	42	43	46	51	57	66	72	78	11.4	11.3
Integrated Circuits	30	32	34	39	45	53	59	64	14.1	13.5
MOS Digital	10	10	10	11	13	16	17	18	8.7	11.8
MOS Memory	2	3	3	3	3	3	4	4	4.0	10.4
MOS Microcomponents	6	6	6	7	8	11	11	12	10.9	12.6
MOS Logic	2	1	1	2	2	2	2	2	7.1	10.4
Bipolar Digital	1	0	0	0	0	0	0	0	-50.0	-100.0
Bipolar Memory	0	0	0	0	0	0	0	0	0	0
Bipolar Logic	1	0	0	0	0	0	0	0	-50.0	-100.0
Analog	19	22	24	28	31	37	42	46	16.9	14.4
Discrete	12	11	11	11	12	13	13	13	3.6	3.2
Optoelectronics	1	1	1	1	1	1	1	1	0	3.1

Note: Some columns do not add to totals shown because of rounding.
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Table 49b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Audio
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.060	.062	.065	.070	.078	.088	.095	.100
Integrated Circuits	.042	.045	.048	.054	.061	.071	.077	.083
MOS Digital	.014	.014	.015	.016	.018	.022	.022	.023
MOS Memory	.003	.004	.004	.004	.004	.005	.005	.005
MOS Microcomponents	.008	.008	.009	.010	.011	.014	.014	.015
MOS Logic	.002	.002	.002	.002	.003	.003	.003	.003
Bipolar Digital	.001	0	0	0	0	0	0	0
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.001	0	0	0	0	0	0	0
Analog	.027	.031	.033	.038	.043	.049	.055	.060
Discrete	.017	.016	.016	.016	.016	.017	.017	.017
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 50a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Video
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	2,865	3,407	3,375	3,451	3,627	3,774	3,907	4,030	2.3	3.6
Total Semiconductor	215	268	271	298	331	382	415	447	9.9	10.6
Integrated Circuits	150	196	201	225	255	301	333	365	12.1	12.7
MOS Digital	59	74	72	77	89	110	115	127	6.1	12.0
MOS Memory	24	35	30	30	33	40	44	52	1.7	11.8
MOS Microcomponents	24	28	31	35	41	51	52	57	10.5	12.7
MOS Logic	11	10	11	12	15	19	19	19	5.4	10.8
Bipolar Digital	4	3	2	2	1	1	1	0	-27.3	-28.9
Bipolar Memory	1	1	1	1	1	0	0	0	-30.0	-27.5
Bipolar Logic	3	2	1	1	1	1	0	0	-25.0	-30.1
Analog	87	119	126	147	165	191	218	237	16.2	13.5
Discrete	61	67	65	68	71	75	77	77	4.1	3.4
Optoelectronics	5	5	5	5	5	5	5	5	-2.0	0

Note: Some columns do not add to totals shown because of rounding.
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Table 50b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Video
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.075	.079	.080	.086	.091	.101	.106	.111
Integrated Circuits	.052	.058	.059	.065	.070	.080	.085	.091
MOS Digital	.021	.022	.021	.022	.024	.029	.029	.032
MOS Memory	.008	.010	.009	.009	.009	.011	.011	.013
MOS Microcomponents	.008	.008	.009	.010	.011	.014	.013	.014
MOS Logic	.004	.003	.003	.003	.004	.005	.005	.005
Bipolar Digital	.001	.001	.001	0	0	0	0	0
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.001	0	0	0	0	0	0	0
Analog	.030	.035	.037	.043	.045	.051	.056	.059
Discrete	.021	.020	.019	.020	.020	.020	.020	.019
Optoelectronics	.002	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 51a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Personal Electronics
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	405	479	491	505	518	533	550	566	2.9	2.9
Total Semiconductor	23	27	29	32	36	42	46	50	11.5	11.6
Integrated Circuits	18	22	23	26	30	36	40	43	13.9	13.4
MOS Digital	7	8	8	9	11	14	15	16	9.5	13.3
MOS Memory	2	2	2	2	2	3	3	3	5.3	11.0
MOS Microcomponents	4	4	5	6	7	8	9	9	12.2	13.9
MOS Logic	2	1	2	2	2	3	3	3	6.2	14.1
Bipolar Digital	1	1	0	0	0	0	0	0	-33.3	-100.0
Bipolar Memory	0	0	0	0	0	0	0	0	0	0
Bipolar Logic	1	1	0	0	0	0	0	0	-33.3	-100.0
Analog	10	13	14	17	19	22	25	28	17.4	14.0
Discrete	4	5	5	5	5	5	5	5	4.4	2.9
Optoelectronics	1	1	1	1	1	1	1	1	-10.0	-2.1

Note: Some columns do not add to totals shown because of rounding.
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Table 51b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Personal Electronics
Region of Production: Worldwide
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.056	.057	.058	.063	.069	.079	.084	.087
Integrated Circuits	.043	.045	.047	.052	.058	.067	.072	.077
MOS Digital	.017	.016	.017	.018	.021	.026	.027	.028
MOS Memory	.004	.005	.004	.004	.004	.005	.005	.006
MOS Microcomponents	.009	.008	.010	.011	.013	.016	.016	.017
MOS Logic	.004	.003	.003	.003	.004	.005	.005	.005
Bipolar Digital	.002	.001	.001	0	0	0	0	0
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.002	.001	.001	0	0	0	0	0
Analog	.024	.028	.029	.033	.037	.041	.046	.049
Discrete	.010	.010	.009	.009	.009	.010	.010	.009
Optoelectronics	.002	.002	.002	.002	.002	.002	.002	.002

Source: Dataquest (August 1991)

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Table 52a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Appliances
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	10,480	11,430	11,359	11,618	12,334	12,974	13,666	14,293	2.3	4.7
Total Semiconductor	659	761	761	859	988	1,174	1,311	1,443	12.9	13.7
Integrated Circuits	504	605	609	699	816	988	1,117	1,243	14.7	15.3
MOS Digital	209	245	230	248	296	370	395	437	7.8	13.7
MOS Memory	94	129	102	106	122	148	164	187	3.2	12.8
MOS Microcomponents	80	86	95	108	130	165	172	192	12.9	15.0
MOS Logic	35	29	32	34	45	57	59	58	7.2	12.6
Bipolar Digital	10	6	5	4	3	2	2	2	-17.4	-20.1
Bipolar Memory	0	0	0	0	0	0	0	0	0	0
Bipolar Logic	10	6	5	4	3	2	2	2	-17.4	-20.1
Analog	285	354	375	448	516	615	720	805	19.4	16.5
Discrete	146	148	145	154	166	179	187	193	6.0	5.9
Optoelectronics	9	9	7	6	7	7	7	7	-3.1	2.1

Note: Some columns do not add to totals shown because of rounding.
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Table 52b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Appliances
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.063	.067	.067	.074	.080	.091	.096	.101
Integrated Circuits	.048	.053	.054	.060	.066	.076	.082	.087
MOS Digital	.020	.021	.020	.021	.024	.029	.029	.031
MOS Memory	.009	.011	.009	.009	.010	.011	.012	.013
MOS Microcomponents	.008	.008	.008	.009	.010	.013	.013	.013
MOS Logic	.003	.003	.003	.003	.004	.004	.004	.004
Bipolar Digital	.001	.001	0	0	0	0	0	0
Bipolar Memory	0	0	0	0	0	0	0	0
Bipolar Logic	.001	.001	0	0	0	0	0	0
Analog	.027	.031	.033	.039	.042	.047	.053	.056
Discrete	.014	.013	.013	.013	.013	.014	.014	.013
Optoelectronics	.001	.001	.001	.001	.001	.001	.001	.001

Source: Dataquest (August 1991)

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Table 53a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Other Consumer
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	1,001	1,068	1,073	1,100	1,155	1,205	1,258	1,307	2.5	4.0
Total Semiconductor	87	99	96	106	123	147	165	181	11.1	13.6
Integrated Circuits	61	73	70	80	94	116	133	148	14.4	16.1
MOS Digital	26	33	28	30	37	49	55	61	9.7	17.1
MOS Memory	13	20	13	14	16	22	25	28	3.8	16.9
MOS Microcomponents	9	10	11	13	16	20	21	24	15.5	16.7
MOS Logic	4	3	4	4	6	8	8	9	13.5	18.9
Bipolar Digital	2	2	2	2	1	1	1	1	-21.1	-13.9
Bipolar Memory	1	2	1	1	1	1	1	1	-18.2	-8.6
Bipolar Logic	1	1	1	1	1	0	0	0	-25.0	-24.2
Analog	33	38	40	48	55	66	77	86	19.3	16.3
Discrete	23	23	23	24	26	28	29	30	2.6	5.5
Optoelectronics	3	2	3	3	3	3	3	3	-3.8	2.2

Note: Some columns do not add to totals shown because of rounding.
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Table 53b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company:	All
Product:	Other Consumer
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.087	.093	.089	.097	.106	.122	.131	.138
Integrated Circuits	.061	.069	.065	.073	.082	.097	.105	.113
MOS Digital	.026	.031	.026	.028	.032	.041	.044	.047
MOS Memory	.013	.019	.012	.012	.014	.018	.020	.022
MOS Microcomponents	.009	.009	.010	.012	.014	.017	.017	.018
MOS Logic	.004	.003	.003	.004	.005	.006	.007	.007
Bipolar Digital	.002	.002	.002	.001	.001	.001	.001	.001
Bipolar Memory	.001	.001	.001	.001	.001	.001	.001	.001
Bipolar Logic	.001	.001	.001	.001	0	0	0	0
Analog	.032	.036	.038	.044	.048	.055	.061	.066
Discrete	.023	.022	.022	.022	.022	.023	.023	.023
Optoelectronics	.003	.002	.002	.002	.002	.002	.002	.002

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Table 54a
Estimated Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Military/Aerospace
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	58,179	59,876	60,569	56,476	59,934	62,275	64,419	67,195	-6.8	2.1
Total Semiconductor	1,999	2,059	2,038	2,016	2,161	2,297	2,440	2,607	-1.1	5.1
Integrated Circuits	1,585	1,655	1,647	1,635	1,748	1,859	1,982	2,127	-0.7	5.2
MOS Digital	756	863	865	895	977	1,090	1,205	1,330	3.5	9.0
MOS Memory	288	334	298	305	330	367	412	457	2.2	8.9
MOS Microcomponents	176	192	204	212	234	268	296	329	4.0	10.1
MOS Logic	292	337	363	378	414	455	496	544	4.2	8.4
Bipolar Digital	432	391	361	339	339	314	294	279	-6.1	-5.1
Bipolar Memory	75	73	51	46	46	40	37	37	-11.0	-6.3
Bipolar Logic	357	318	310	294	294	274	258	242	-5.3	-4.9
Analog	397	401	421	401	432	455	483	517	-4.7	4.2
Discrete	340	332	321	311	336	349	361	383	-3.1	3.6
Optoelectronics	74	72	70	70	78	89	97	98	0.1	7.0

Note: Some columns do not add to totals shown because of rounding.
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Table 54b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Military/Aerospace
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.034	.034	.034	.036	.036	.037	.038	.039
Integrated Circuits	.027	.028	.027	.029	.029	.030	.031	.032
MOS Digital	.013	.014	.014	.016	.016	.017	.019	.020
MOS Memory	.005	.006	.005	.005	.005	.006	.006	.007
MOS Microcomponents	.003	.003	.003	.004	.004	.004	.005	.005
MOS Logic	.005	.006	.006	.007	.007	.007	.008	.008
Bipolar Digital	.007	.007	.006	.006	.006	.005	.005	.004
Bipolar Memory	.001	.001	.001	.001	.001	.001	.001	.001
Bipolar Logic	.006	.005	.005	.005	.005	.004	.004	.004
Analog	.007	.007	.007	.007	.007	.007	.007	.008
Discrete	.006	.006	.005	.005	.006	.006	.006	.006
Optoelectronics	.001	.001	.001	.001	.001	.001	.002	.001

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Table 55a
Semiconductor Consumption Forecast
(Factory Revenue in Millions of Dollars)

Company:	All
Product:	Transportation
Region of Production:	North America
Distribution Channel:	Not Meaningful
Application:	All
Specification:	All

	1988	1989	1990	1991	1992	1993	1994	1995	1990-1991 Growth Rate (%)	1990-1995 CAGR (%)
Electronic Equipment	4,131	4,151	4,115	4,024	4,535	4,996	5,424	5,721	-2.2	6.8
Total Semiconductor	955	948	956	952	1,094	1,216	1,330	1,413	-0.4	8.1
Integrated Circuits	802	778	786	779	895	992	1,084	1,155	-0.9	8.0
MOS Digital	597	580	577	569	640	700	763	810	-1.4	7.0
MOS Memory	73	65	58	52	57	61	64	67	-10.1	2.7
MOS Microcomponents	239	221	213	202	219	233	255	269	-5.0	4.8
MOS Logic	285	294	305	314	363	407	445	475	2.8	9.2
Bipolar Digital	17	17	31	30	43	46	49	52	-5.4	10.7
Bipolar Memory	3	2	2	1	1	1	1	0	-18.8	-24.2
Bipolar Logic	14	15	30	28	42	45	49	52	-4.7	11.7
Analog	188	181	178	181	213	246	271	292	1.6	10.4
Discrete	131	148	148	149	172	197	218	229	0.9	9.2
Optoelectronics	22	22	23	24	26	27	28	30	6.6	5.4

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (August 1991)

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Table 55b
Semiconductor Consumption Forecast
(Input/Output Ratios)

Company: All
Product: Transportation
Region of Production: North America
Distribution Channel: Not Meaningful
Application: All
Specification: All

	1988	1989	1990	1991	1992	1993	1994	1995
Total Semiconductor	.231	.228	.232	.237	.241	.243	.245	.247
Integrated Circuits	.194	.187	.191	.194	.197	.199	.200	.202
MOS Digital	.145	.140	.140	.141	.141	.140	.141	.142
MOS Memory	.018	.016	.014	.013	.013	.012	.012	.012
MOS Microcomponents	.058	.053	.052	.050	.048	.047	.047	.047
MOS Logic	.069	.071	.074	.078	.080	.081	.082	.083
Bipolar Digital	.004	.004	.008	.007	.009	.009	.009	.009
Bipolar Memory	.001	0	0	0	0	0	0	0
Bipolar Logic	.003	.004	.007	.007	.009	.009	.009	.009
Analog	.046	.044	.043	.045	.047	.049	.050	.051
Discrete	.032	.036	.036	.037	.038	.039	.040	.040
Optoelectronics	.005	.005	.006	.006	.006	.005	.005	.005

Source: Dataquest (August 1991)

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Market Statistics

Consumer Electronics—North America

October 1991

Source:
Dataquest

Semiconductor Application Markets *Worldwide*

Dataquest

Market Statistics:

Consumer Electronics—North America

October 1991

Source: Dataquest

Dataquest **Semiconductor Application Markets** *Worldwide*

Published by Dataquest Incorporated

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Market Statistics: Consumer Electronics—North America

Table 1
1990 Demographic Information for G7 Countries

Country	Population (M)	Households (M)	Per Capita Income ($)
Canada	27	9	18,070
France	56	26	16,800
Germany	79	36	16,800
West Germany	63	28	18,370
East Germany	16	8	12,500
Italy	58	25	14,953
Japan	124	40	15,030
United Kingdom	57	24	13,329
United States	251	92	19,800

Source: Government Statistics, Dataquest (October 1991)

Table 2
Consumer Electronics Potential Indicators in the United States—New Housing Starts and Per Capita Disposable Personal Income

	1980	1981	1982	1983	1984	1985
New Housing Starts (Thousands of Units)	1,292	1,084	1,062	1,703	1,750	1,745
Per Capita Disposable Personal Income (In 1982 Dollars)	9,722	9,769	9,725	9,930	10,419	10,625
	1986	**1987**	**1988**	**1989**	**1990***	**1991***
New Housing Starts (Thousands of Units)	1,807	1,623	1,488	1,376	1,220	1,150
Per Capita Disposable Personal Income (In 1982 Dollars)	10,970	10,970	11,340	11,670	11,850	NA

*Estimated
NA = Not available
Source: U.S. Department of Commerce, Dataquest (October 1991)

Table 3
1990 U.S. Consumer Electronics Trade Estimates
(Millions of Units)

Company: All
Product: Video and Audio
Region of Consumption: North America
Distribution Channel: All

Product	Consumption	Imports	Production	Exports
Audio Equipment	43.2	40.5	4.5	1.8
Color TVs	21.0	9.3	13.9	2.2
Monochrome TVs	1.5	2.2	0	.8
Radios	21.6	35.2	0	2.9
VCRs	13.1	15.9	1.0	0

Source: EIA, Dataquest (October 1991)

Table 4
North American Consumer Equipment Production
(Millions of Dollars)

Company: All
Product: All
Region of Consumption: North America
Distribution Channel: All

	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Compact Disc Players	8.2	8.5	8.7	8.8	9.0	9.1	9.3	1.8
Radio	228.0	233.3	241.5	246.3	251.1	256.1	261.2	2.3
Stereo (Hi-Fi) Components	207.5	207.0	209.0	213.2	217.4	221.8	226.2	1.8
Musical Instruments	235.0	240.0	245.0	250.0	255.0	260.0	265.0	2.0
Tape Recorders	18.5	17.8	17.5	17.3	17.1	16.8	16.6	-1.4
Audio	697.2	706.6	721.7	735.6	749.6	763.8	778.3	2.0
Video Cameras	10.0	0	0	0	0	0	0	0
VTRs (VCRs)	235.1	265.1	275.5	294.3	314.0	328.9	344.6	5.4
Videodisk Players	.9	1.0	1.0	1.0	1.1	1.1	1.1	1.9
Color Televisions	3160.1	3109.5	3174.9	3332.3	3459.7	3577.0	3683.9	3.4
Video	3406.1	3375.6	3451.4	3627.6	3774.8	3907.0	4029.6	3.6
Games	301.0	316.1	331.9	348.4	365.9	384.2	403.1	5.0
Cameras	25.0	25.3	25.3	23.4	23.4	23.4	22.9	-2.0
Watches	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0
Clocks	53.0	50.0	48.0	46.0	44.0	42.0	40.0	-4.4
Personal Electronics	479.0	491.4	505.2	517.8	533.3	549.6	566.0	2.9
Air Conditioners	1,845.9	1,845.3	1,836.2	1,845.0	1,868.6	3,254.1	1,949.5	1.1
Microwave Ovens	619.2	506.7	467.8	523.9	557.4	505.3	586.6	3.0
Washers and Dryers	2,980.5	2,934.2	2,971.3	3,111.8	3,236.4	2,996.9	3,581.4	4.1
Refrigerators	4,023.4	4,236.1	4,559.0	4,991.2	5,366.6	5,101.9	6,059.1	7.4
Dishwashers	978.7	947.9	942.8	974.8	1,023.4	957.8	1,147.8	3.9
Ranges and Ovens	982.1	889.0	840.5	887.0	921.4	850.1	968.9	1.7
Appliances	11,429.8	11,359.2	11,617.6	12,333.7	12,973.8	13,666.1	14,293.3	4.7
Automatic Garage Door Openers	254.9	256.5	260.1	265.1	271.4	279.0	287.4	2.3
Consumer Equipment NEC*	813.4	816.5	839.9	889.9	933.6	979.0	1,019.6	4.5
Other Consumer	1,068.3	1,073.0	1,100.0	1,155.0	1,205.0	1,258.0	1,307.0	4.0
Consumer	17,080.4	17,005.8	17,395.9	18,369.7	19,236.5	20,144.5	20,974.2	4.3

*NEC = Not elsewhere classified
Source: Dataquest (October 1991)

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Table 5
Major Consumer Equipment Manufacturers with U.S. Facilities

Manufacturer	Products
Emerson Radio	Audio
General Electric	Appliances
Kodak	Personal electronics
Litton Industries	Appliances
Matsushita Electric	Video
Mitsubishi Electric	Video
North American Philips	Video
Pioneer Electronics	Audio
Polaroid	Personal electronics
Raytheon	Appliances
Sanyo	Video, audio
Sharp	Video
Sony	Video
Tandy	Audio, personal electronics
Thomson	Video
Texas Instruments	Personal electronics
Toshiba	Video, audio
White Consolidated Industries	Appliances
Whirlpool	Appliances
Zenith	Video

Source: *Appliance*, Dataquest (October 1991)

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Table 6
Estimated U.S. Audio Equipment Consumption
(Millions of Units)

Company: All
Product: Audio
Region of Consumption: North America
Distribution Channel: All

Audio Equipment	Consumption	Penetration (%)	Replacement
Total Audio Equipment	70.6	NA	NA,
Portable Audio Equipment	39.1	NA	NA
Players Only	4.7	NA	NA
Radio/Tape/CD Combinations	29.2	NA	NA
Recorders/Players	5.3	NA	NA
Home Radios	21.5	98	NA
Clock Radios	11.5	NA	NA
Portable Radios	9.7	NA	NA
Table Radios	.4	NA	NA
Audio Hi-Fi Systems	9.9	93	NA
Compact Systems	2.4	61	2.7
Component Systems	7.5	53	NA
Amps and Preamps	.4	NA	NA
Cassette Decks	.8	NA	NA
Compact Disc Players	3.9	25	NA
Equalizers	.2	NA	NA
Receivers	2.0	NA	1.5
Tuners	.3	NA	NA

NA = Not available
Source: *Appliance*, EIA, Dataquest (October 1991)

Table 7
Estimated U.S. Video Equipment Consumption—1990
(Millions of Units)

Company: All
Product: Video
Region of Consumption: North America
Distribution Channel: All

Video Equipment	Consumption	Penetration (%)	Replacement
Total Video Equipment	36.2	NA	NA
Color Receivers	21.1	96	13.9
Consoles	1.8	NA	NA
LCD TVs	.5	NA	NA
Projection TVs	.3	7	.1
Table and Portable	18.5	NA	NA
TV/VCR Combined	.5	NA	NA
Videocassette Recorders	13.1	NA	4.1
VCR Decks	10.1	72	NA
Camcorders	3.0	13	NA
Monochrome Receivers	1.5	56	5.8
Satellite Earth Stations	.3	3	NA
Videodisk Players	.2	7	NA

NA = Not available
Source: *Appliance*, EIA, Dataquest (October 1991)

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Table 8
Estimated U.S. Video Equipment Market Shares

Video Equipment	Number 1	Market Share (%)	Number 2	Market Share (%)	Number 3	Market Share (%)
Camcorders	Sony	18	Thomson	18	Matsushita	14
Color TVs	Thomson	21	Philips	13	Zenith	12
VCRs	Matsushita	21	Thomson	15	Emerson	9
Videodisk Players	Pioneer	40	Sony	35	Matsushita	7

Source: *Appliance*, Dataquest (October 1991)

Table 9
Estimated U.S. Appliance Consumption
(Millions of Units)

Company: All
Product: Appliances
Region of Consumption: North America
Distribution Channel: All

Appliance	Consumption	Penetration (%)	Replacement
Total Appliances	91.3	NA	NA
Electric Housewares	43.7	NA	NA
Irons	15.6	90	10.8
Coffeemakers	17.8	73	15.5
Smoke Detectors	10.4	NA	7.0
Major Appliances	40.2	NA	NA
Microwave Ovens	9.4	84	3.6
Refrigerators	8.0	100	5.1
Ranges	7.8	59	5.3
Dryers	4.8	45	3.6
Washers	6.5	73	4.8
Dishwashers	3.6	52	2.5
Air Conditioners	7.4	32	5.6

NA = Not available
Source: *Appliance*, EIA, Dataquest (October 1991)

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Table 10
Estimated U.S. Appliance Market Shares

Appliance	Number 1	Market Share (%)	Number 2	Market Share (%)	Number 3	Market Share (%)
Air Conditioners	Fedders	23	Electrolux	19	Whirlpool	19
Dishwashers	GE	40	Whirlpool	32	Maytag	7
Dryers	Whirlpool	51	GE	16	Maytag	16
Microwave Ovens	Sharp	18	Samsung	17	Matsushita	15
Ranges	GE	30	Electrolux	22	Whirlpool	10
Refrigerators	GE	34	Whirlpool	23	Electrolux	20
Washers	Whirlpool	51	Maytag	18	GE	16

Source: *Appliance*, Dataquest (October 1991)

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Market Statistics

Transportation Electronics—North America

October 1991

Source:
Dataquest

Semiconductor Application Markets *Worldwide*

Dataquest

Market Statistics:

Transportation Electronics—North America

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Market Statistics: Transportation Electronics—North America

Table 1
Auto and Light Truck Production
(Millions of Units)

Company:	All
Product:	Transportation
Region of Production:	North America
Distribution Channel:	All
Specification:	Auto and light truck

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Auto	8,522	7,972	7,132	6,320	6,736	7,128	7,514	7,609	1.3
Light Truck	4,416	4,749	4,630	4,265	4,324	4,372	4,446	4,491	-.6
Total	12,938	12,721	11,762	10,585	11,060	11,500	11,960	12,100	.6

Source: Dataquest (October 1991)

Table 2
Auto and Light Truck Production by Share by Manufacturer

Company:	All
Product:	Transportation
Region of Production:	North America
Distribution Channel:	All
Specification:	Auto and light truck

Company	1985	1986	1987	1988	1989	1990
General Motors	53.0	48.2	46.4	44.1	41.8	41.1
Ford	25.8	28.9	29.7	30.2	30.0	27.9
Chrysler	16.4	15.9	15.8	16.7	15.6	14.0
Honda	1.1	1.9	2.6	3.2	3.4	4.6
Toyota	NM	NM	NM	NM	1.3	2.4
Nissan	1.1	1.3	1.7	1.6	1.8	2.0
Nummi	.4	1.6	1.5	1.0	1.5	1.7
Mazda	NM	NM	NM	1.2	1.7	1.5
Others	2.2	2.2	2.3	2.0	2.9	4.8

NM = Not meaningful
Source: Dataquest (October 1991)

Table 3
Factory Installed Entertainment Systems

Company: All
Product: Transportation
Region of Production: North America
Distribution Channel: All
Specification: Entertainment Systems

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
AM-FM Stereo/Cassette							
Units (M)	5.72	5.35	5.81	6.27	6.76	7.08	4.4
Penetration (%)	48.6	50.5	52.5	54.5	56.5	58.5	3.8
Factory ASP ($)	95.0	91.0	87.0	84.0	81.0	79.0	-3.6
Revenue ($M)	543.4	486.7	505.2	526.5	547.3	559.2	.6
I/O Ratio (%)	19	20	20	21	21	21	2.0
Semiconductor TAM ($M)	103.2	94.9	101.0	107.9	114.9	117.4	2.6
Semiconductor per Unit ($)	18.05	17.75	17.40	17.22	17.01	16.59	-1.7
AM-FM Stereo/Cassette (with Equalizer)							
Units (M)	1.65	1.59	1.77	1.96	2.15	2.30	6.9
Penetration (%)	14.0	15.0	16.0	17.0	18.0	19.0	6.3
Factory ASP ($)	102.0	99.0	96.0	94.0	92.0	90.0	-2.5
Revenue ($M)	168.3	157.3	169.9	183.8	198.1	206.9	4.2
I/O Ratio (%)	20	21	21	21	22	22	1.9
Semiconductor TAM ($M)	33.7	32.2	35.7	39.1	42.6	45.5	6.2
Semiconductor per Unit ($)	20.40	20.30	20.16	20.02	19.78	19.80	-.6
AM-FM Stereo							
Units (M)	2.90	2.38	2.27	2.13	1.97	1.75	-9.6
Penetration (%)	24.7	22.5	20.5	18.5	16.5	14.5	-10.1
Factory ASP ($)	64.0	60.0	56.0	53.0	50.0	48.0	-5.6
Revenue ($M)	185.6	143.0	127.0	112.8	98.7	84.2	-14.6
I/O Ratio (%	19	19	20	20	21	21	2.0
Semiconductor TAM ($M)	35.3	27.2	25.4	22.6	20.7	17.7	-12.9
Semiconductor per Unit ($)	12.16	11.40	11.20	10.60	10.50	10.08	-3.7
AM-FM/CD/Equalizer							
Units (M)	.16	.19	.24	.30	.36	.42	21.5
Penetration (%)	1.4	1.8	2.2	2.6	3.0	3.5	20.8
Factory ASP ($)	103.0	100.0	97.0	95.0	94.0	92.0	-2.2
Revenue ($M)	16.5	19.1	23.6	28.4	33.7	39.0	18.8
I/O Ratio (%)	22	22	23	23	23	23	.9
Semiconductor TAM ($M)	3.6	4.2	5.4	6.5	7.8	9.0	19.8
Semiconductor per Unit ($)	22.66	22.00	22.31	21.85	21.62	21.16	-1.4

Source: Dataquest (October 1991)

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Table 4
Factory Installed Vehicle Control Systems/Modules

Company: All
Product: Transportation
Region of Production: North America
Distribution Channel: All
Specification: Vehicle Control Systems/Modules

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
ABS							
Units (M)	4.22	4.77	6.30	7.82	9.33	10.65	20.3
Penetration (%)	35.9	45.0	57.0	68.0	78.0	88.0	19.7
Factory ASP ($)	43.0	43.0	42.0	42.0	43.0	44.0	.5
Revenue ($M)	181.5	204.9	264.8	328.4	401.1	468.5	20.9
I/O Ratio (%)	35	35	36	36	37	37	1.1
Semiconductor TAM ($M)	63.5	71.7	94.0	118.2	146.4	173.3	22.2
Semiconductor per Unit ($)	15.05	15.05	14.91	15.12	15.70	16.28	1.6
Cruise Control							
Units (M)	8.08	7.52	7.96	8.40	8.85	9.08	2.3
Penetration (%)	68.7	71.0	72.0	73.0	74.0	75.0	1.8
Factory ASP ($)	26.0	26.0	25.0	24.0	24.0	23.0	-2.4
Revenue ($M)	210.1	195.5	199.1	201.5	212.4	208.7	-.1
I/O Ratio (%)	40	40	40	40	40	40	0
Semiconductor TAM ($M)	84.0	78.2	79.6	80.6	85.0	83.5	-.1
Semiconductor per Unit ($)	10.40	10.40	10.00	9.60	9.60	9.20	-2.4
Electronic Power Steering							
Units (M)	.37	.34	.39	.45	.53	.67	12.5
Penetration (%)	3.1	3.2	3.5	3.9	4.4	5.5	11.8
Factory ASP ($)	30.0	30.0	29.0	28.0	27.0	26.0	-2.8
Revenue ($M)	11.1	10.2	11.2	12.6	14.2	17.3	9.3
I/O Ratio (%)	37	37	37	37	37	37	0
Semiconductor TAM ($M)	4.1	3.8	4.2	4.6	5.3	6.4	9.3
Semiconductor per Unit ($)	11.10	11.10	10.73	10.36	9.99	9.62	-2.8
Ride Level Control							
Units (M)	.70	.68	.73	.78	.84	.87	4.5
Penetration (%)	6.0	6.4	6.6	6.8	7.0	7.2	3.9
Factory ASP ($)	42.0	41.0	40.0	40.0	39.0	37.0	-2.5
Revenue ($M)	29.4	27.8	29.2	31.3	32.7	32.2	1.9
I/O Ratio (%)	30	30	30	30	30	30	0
Semiconductor TAM ($M)	8.8	8.3	8.8	9.4	9.8	9.7	1.9
Semiconductor per Unit ($)	12.60	12.30	12.00	12.00	11.70	11.10	-2.5
Suspension Control							
Units (M)	.54	.54	.66	.92	1.32	1.82	27.4
Penetration (%)	4.6	5.1	6.0	8.0	11.0	15.0	26.7
Factory ASP ($)	36.0	36.0	35.0	34.0	32.0	31.0	-2.9
Revenue ($M)	19.4	19.4	23.2	31.3	42.1	56.3	23.7
I/O Ratio (%)	45	45	45	45	45	45	0
Semiconductor TAM ($M)	8.7	8.7	10.5	14.1	18.9	25.3	23.7
Semiconductor per Unit ($)	16.20	16.20	15.75	15.30	14.40	13.95	-2.9

Source: Dataquest (October 1991)

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Table 5
Factory Installed Body Control Systems/Modules

Company: All
Product: Transportation
Region of Production: North America
Distribution Channel: All
Specification: Body Control Systems/Modules

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Multiplex Systems Door, etc.							
Units (M)	.08	.08	.13	.32	.42	.54	46.8
Penetration (%)	.7	.8	1.2	2.8	3.5	4.5	45.9
Factory ASP ($)	28.0	27.0	26.0	25.0	24.0	23.0	-3.9
Revenue ($M)	2.2	2.3	3.5	8.1	10.0	12.5	41.1
I/O Ratio (%)	38	38	38	38	38	38	0
Semiconductor TAM ($M)	.9	.9	1.3	3.1	3.8	4.8	41.1
Semiconductor per Unit ($)	10.64	10.26	9.88	9.50	9.12	8.74	-3.9
Lighting Controls							
Units (M)	10.80	10.38	11.61	12.65	13.75	14.52	6.1
Penetration (%)	91.8	98.0	105.0	110.0	115.0	120.0	5.5
Factory ASP ($)	6.5	6.4	6.3	6.2	6.1	6.0	-1.6
Revenue ($M)	70.2	66.4	73.2	78.4	83.9	87.1	4.4
I/O Ratio (%)	36	36	36	36	36	36	0
Semiconductor TAM ($M)	25.3	23.9	26.3	28.2	30.2	31.4	4.4
Semiconductor per Unit ($)	2.34	2.30	2.27	2.23	2.20	2.16	-1.6

Source: Dataquest (October 1991)

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Table 6
Factory Installed Driver Information Systems/Modules

Company: All
Product: Transportation
Region of Production: North America
Distribution Channel: All
Specification: Driver Information Systems/Modules

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Electronic Instrument Cluster							
Units (M)	7.89	7.20	7.63	8.17	8.61	8.83	2.3
Penetration (%)	67.1	68.0	69.0	71.0	72.0	73.0	1.7
Factory ASP ($)	51.0	50.0	49.0	48.0	47.0	46.0	-2.0
Revenue ($M)	402.4	360.1	373.9	391.9	404.7	406.3	.2
I/O Ratio (%)	20	20	20	20	20	20	0
Semiconductor TAM ($M)	80.5	72.0	74.8	78.4	80.9	81.3	.2
Semiconductor per Unit ($)	10.20	10.00	9.80	9.60	9.40	9.20	-2.0
Diagnostic Display							
Units (M)	1.75	1.75	1.94	2.13	2.33	2.48	7.2
Penetration (%)	14.9	16.5	17.5	18.5	19.5	20.5	6.6
Factory ASP ($)	42.0	41.0	40.0	39.0	38.0	37.0	-2.5
Revenue ($M)	73.5	71.6	77.4	83.0	88.6	91.8	4.5
I/O Ratio (%)	43	43	43	43	43	43	0
Semiconductor TAM ($M)	31.6	30.8	33.3	35.7	38.1	39.5	4.5
Semiconductor per Unit ($)	18.06	17.63	17.20	16.77	16.34	15.91	-2.5
Trip Computer							
Units (M)	.88	.85	.94	1.04	1.20	1.33	8.6
Penetration (%)	7.5	8.0	8.5	9.0	10.0	11.0	8.0
Factory ASP ($)	48.0	47.0	46.0	45.0	44.0	43.0	-2.2
Revenue ($M)	42.2	39.8	43.2	46.6	52.6	57.2	6.3
I/O Ratio (%)	45	45	45	45	45	45	0
Semiconductor TAM ($M)	19.0	17.9	19.5	21.0	23.7	25.8	6.3
Semiconductor per Unit ($)	21.60	21.15	20.70	20.25	19.80	19.35	-2.2
Navigation System							
Units (M)	.01	.02	.04	.08	.16	.35	103.6
Penetration (%)	.1	.2	.4	.7	1.3	2.9	102.5
Factory ASP ($)	800.0	720.0	648.0	583.0	525.0	505.0	-8.8
Revenue ($M)	8.0	14.4	25.9	46.6	84.0	176.8	85.7
I/O Ratio (%)	18	19	21	22	22	22	4.1
Semiconductor TAM ($M)	1.4	2.7	5.4	10.3	18.5	38.9	93.3
Semiconductor per Unit ($)	144.00	136.80	136.08	128.26	115.50	111.10	-5.1

Source: Dataquest (October 1991)

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Table 7
Factory Installed Powertrain Systems/Modules

Company: All
Product: Transportation
Region of Production: North America
Distribution Channel: All
Specification: Power Train Systems/Modules

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Integrated Engine Control							
Units (M)	2.76	2.43	2.52	2.61	2.70	2.72	-.3
Penetration (%)	23.5	22.9	22.8	22.7	22.6	22.5	-.8
Factory ASP ($)	84.0	83.0	81.0	78.0	76.0	74.0	-2.5
Revenue ($M)	231.8	201.3	204.3	203.6	205.4	201.5	-2.8
I/O Ratio (%)	49	49	49	49	49	49	0
Semiconductor TAM ($M)	113.6	98.6	100.1	99.8	100.7	98.7	-2.8
Semiconductor per Unit ($)	41.16	40.67	39.69	38.22	37.24	36.26	-2.5
Standalone Fuel Control							
Units (M)	8.64	8.16	8.54	8.89	9.26	9.38	1.7
Penetration (%)	76.5	77.1	77.2	77.3	77.4	77.5	.3
Factory ASP ($)	76.0	76.0	75.0	75.0	74.0	74.0	-.5
Revenue ($M)	656.6	620.5	640.4	666.7	685.0	693.9	1.1
I/O Ratio (%)	29	29	29	29	29	29	0
Semiconductor TAM ($M)	190.4	180.0	185.7	193.3	198.7	201.2	1.1
Semiconductor per Unit ($)	22.04	22.04	21.75	21.75	21.46	21.46	-.5
Standalone Engine Control (Ignition, Regulators, etc.)							
Units (M)	20.40	19.59	22.12	24.73	26.31	27.23	5.9
Penetration (%)	173.5	185.0	200.0	215.0	220.0	225.0	5.3
Factory ASP ($)	10.5	10.3	10.1	9.9	9.7	9.5	-2.0
Revenue ($M)	214.2	201.8	223.4	244.8	255.2	258.6	3.8
I/O Ratio (%)	48	48	48	48	48	48	0
Semiconductor TAM ($M)	102.8	96.9	107.2	117.5	122.5	124.1	3.8
Semiconductor per Unit ($)	5.04	4.94	4.85	4.75	4.66	4.56	-2.0
Transmission Control (included in engine control partially)							
Units (M)	1.60	2.01	2.43	2.88	3.35	3.75	18.6
Penetration (%)	13.6	19.0	22.0	25.0	28.0	31.0	17.9
Factory ASP ($)	65.0	64.0	63.0	61.0	59.0	58.0	-2.3
Revenue ($M)	104.0	128.8	153.3	175.4	197.6	217.6	15.9
I/O Ratio (%)	49	49	49	49	49	49	0
Semiconductor TAM ($M)	51.0	63.1	75.1	85.9	96.8	106.6	15.9
Semiconductor per Unit ($)	31.85	31.36	30.87	29.89	28.91	28.42	-2.3
Distributorless Ignition							
Units (M)	1.37	1.69	2.21	2.76	3.47	4.24	25.3
Penetration (%)	11.6	16.0	20.0	24.0	29.0	35.0	24.6
Factory ASP ($)	28.0	28.0	27.0	26.0	25.0	24.0	-3.0
Revenue ($M)	38.4	47.4	59.7	71.8	86.7	101.6	21.5
I/O Ratio (%)	35	35	35	35	35	35	0
Semiconductor TAM ($M)	13.4	16.6	20.9	25.1	30.3	35.6	21.5
Semiconductor per Unit ($)	9.80	9.80	9.45	9.10	8.75	8.40	-3.0

Source: Dataquest (October 1991)

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Table 8
Factory Installed Safety and Convenience Systems/Modules

Company:	All
Product:	Transportation
Region of Production:	North America
Distribution Channel:	All
Specification:	Safety and Convenience Systems/Modules

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Air Bag Control							
Units (M)	2.06	2.86	3.87	5.75	8.61	9.08	34.5
Penetration (%)	17.5	27.0	35.0	50.0	72.0	75.0	33.8
Factory ASP ($)	45.0	45.0	44.0	42.0	41.0	40.0	-2.3
Revenue ($M)	92.7	128.7	170.3	241.5	353.1	363.0	31.4
I/O Ratio (%)	35	35	35	35	35	35	0
Semiconductor TAM ($M)	32.4	45.0	59.6	84.5	123.6	127.1	31.4
Semiconductor per Unit ($)	15.75	15.75	15.40	14.70	14.35	14.00	-2.3
Seat Belt Control							
Units (M)	2.60	2.91	3.10	3.45	3.35	3.03	3.1
Penetration (%)	22.1	27.5	28.0	30.0	28.0	25.0	2.5
Factory ASP ($)	25.0	25.0	24.0	23.0	22.0	22.0	-2.5
Revenue ($M)	65.0	72.8	74.3	79.4	73.7	66.6	.5
I/O Ratio (%)	28	28	28	28	28	28	0
Semiconductor TAM ($M)	18.2	20.4	20.8	22.2	20.6	18.6	.5
Semiconductor per Unit ($)	7.00	7.00	6.72	6.44	6.16	6.16	-2.5
Automatic Climate Control							
Units (M)	1.52	1.54	1.77	2.01	2.27	2.48	10.3
Penetration (%)	12.9	14.5	16.0	17.5	19.0	20.5	9.7
Factory ASP ($)	32.0	32.0	30.0	30.0	29.0	28.0	-2.6
Revenue ($M)	48.6	49.1	53.1	60.4	65.9	69.5	7.4
I/O Ratio (%)	26	26	26	26	26	26	0
Semiconductor TAM ($M)	12.6	12.8	13.8	15.7	17.1	18.1	7.4
Semiconductor per Unit ($)	8.32	8.32	7.80	7.80	7.54	7.28	-2.6
Interval Wipers							
Units (M)	10.17	9.32	9.90	10.47	11.06	11.37	2.3
Penetration (%)	86.5	88.0	89.5	91.0	92.5	94.0	1.7
Factory ASP ($)	15.0	15.0	14.0	14.0	13.0	13.0	-2.8
Revenue ($M)	152.6	139.8	138.6	146.5	143.8	147.9	-.6
I/O Ratio (%)	28	28	28	28	28	28	0
Semiconductor TAM ($M)	42.7	39.1	38.8	41.0	40.3	41.4	-.6
Semiconductor per Unit ($)	4.20	4.20	3.92	3.92	3.64	3.64	-2.8
Keyless Entry Control							
Units (M)	.28	.30	.31	.48	.51	.58	15.7
Penetration (%)	2.4	2.8	2.8	4.2	4.3	4.8	15.1
Factory ASP ($)	40.0	39.0	38.0	37.0	36.0	35.0	-2.6

(Continued)

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Table 8 (Continued)
Factory Installed Safety and Convenience Systems/Modules

Company: All
Product: Transportation
Region of Production: North America
Distribution Channel: All
Specification: Safety and Convenience Systems/Modules

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Revenue ($M)	11.2	11.6	11.8	17.9	18.5	20.3	12.7
I/O Ratio (%)	23	23	23	23	23	23	0
Semiconductor TAM ($M)	2.6	2.7	2.7	4.1	4.3	4.7	12.7
Semiconductor per Unit ($)	9.20	8.97	8.74	8.51	8.28	8.05	-2.6
Security Controls							
Units (M)	.65	.69	.83	.98	1.14	1.27	14.3
Penetration (%)	5.5	6.5	7.5	8.5	9.5	10.5	13.7
Factory ASP ($)	38.0	37.0	36.0	35.0	34.0	33.0	-2.8
Revenue ($M)	24.7	25.5	29.9	34.2	38.6	41.9	11.2
I/O Ratio (%)	30	30	30	30	30	30	0
Semiconductor TAM ($M)	7.4	7.6	9.0	10.3	11.6	12.6	11.2
Semiconductor per Unit ($)	11.40	11.10	10.80	10.50	10.20	9.90	-2.8

Source: Dataquest (October)

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Table 9
Geographic Auto and Light Truck Production Trends
(Millions of Units)

Company: All
Product: Transportation
Region of Production: Each
Distribution Channel: All
Specification: All

Country	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
United States	11.67	11.37	10.98	11.01	11.12	9.89	-3.3
Canada	1.94	1.86	1.56	1.78	1.94	1.91	-.3
Total North America	13.61	13.24	12.54	12.79	13.06	11.79	-2.8
Japan	12.27	12.26	12.25	12.70	13.03	13.49	1.9
South Korea	.38	.60	.98	1.08	1.13	1.32	28.4
Australia	.41	.36	.33	.35	.36	.37	-1.9
Total Southeast Asia	.79	.96	1.31	1.43	1.49	1.70	16.5
West Germany	4.45	4.58	4.63	4.63	4.85	4.66	.9
France	3.02	3.20	3.49	3.68	3.92	3.30	1.8
Italy	1.57	1.91	1.91	2.11	2.22	1.88	3.6
United Kingdom	1.31	1.20	1.39	1.55	1.63	1.30	-.2
Spain	1.42	1.31	1.70	1.87	2.05	1.68	3.4
Sweden	.46	.49	.50	.49	.47	.34	-6.1
Belgium	.27	.30	.35	.40	.39	.31	3.2
Total Western Europe	12.49	12.98	13.99	14.71	15.52	13.46	1.5
Brazil	.97	1.06	1.06	1.07	1.01	.92	-1.1
Mexico	.40	.34	.40	.51	.63	.82	15.6
Total Latin America	1.37	1.39	1.45	1.58	1.64	1.74	4.9
USSR	2.20	2.23	2.20	2.17	2.10	2.00	-1.9
Worldwide Total	30.45	30.80	31.49	32.67	33.81	30.68	.1

Source: Dataquest (October 1991)

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Table 10
Estimated Electronic Content of the Average North American Vehicle
(Dollars)

Company: All
Product: Electronic Content
Region of Production: All
Distribution Channel: All
Application: Transportation

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Auto	365	373	399	409	442	462	480	498	4.5
Light Truck	231	248	274	283	302	307	318	333	4.0
Average	319	326	350	358	387	403	420	437	4.5

Source: Dataquest (October 1991)

Table 11
Estimated Semiconductor Content of the Average North American Vehicle
(Dollars)

Company: All
Product: Semiconductor
Region of Production: All
Distribution Channel: All
Application: Transportation
Specification: Merchant and Captive

	1988	1989	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Auto	105	108	118	124	133	137	142	146	4.4
Light Truck	67	72	81	86	91	91	94	98	3.9
Average	92	94	103	108	116	120	124	129	4.6

Source: Dataquest (October 1991)

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Table 12
Primary North American Manufacturers of Vehicle Electronic Systems

Company:	Each
Product:	Transportation
Region of Production:	All
Distribution Channel:	All
Specification:	All

Company	Principal Electronic System(s)
Allied-Signal	Aftermarket, ABS
Audiovox	Aftermarket audio, security, cruise control
Chrysler/Acustar	Audio, engine control, displays, body control
Eaton	Engine and body control, climate control
Ford-EED	Engine and body control
General Motors/Delco	Audio, ABS, engine and body control, suspension, displays
Hitachi Automotive	Audio, engine control, ignition modules
ITT	Audio, ABS
Kelsey/Hayes	ABS
Motorola/AIEG	ABS, engine control, sensors, instruments
Nippondenso	Engine control
Robert Bosch	Audio, ABS, engine control, ignition modules
Rockwell International	Body control, suspension, motor control
Siemens	Fuel injection, ABS, ignition modules
TRW	Steering, engine and body control
United Technologies	Switches, ignition systems
Wagner	Lighting control

Source: Dataquest (October 1991)

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Market Statistics:

Communications—North America

October 1991

Source:
Dataquest

Semiconductor Application Markets *Worldwide*

Dataquest

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Communications—North America

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Market Statistics: Communications North America

Summary

This section highlights the consumption of telecommunications services and equipment in the United States. Services will be presented first, and equipment will be presented second.

Services

Centrex Services

The Centrex service typically consists of the following three elements:

- Local exchange access and switching (including long distance access)
- Intercom service
- Call-processing software feature packages

The top suppliers of Centrex services are the Regional Bell Operating Companies (RBOCs), with a 95 percent share of the installed base. Approximately 1,400 independent telephone companies hold the remaining 5 percent share.

Table 1
Estimated Total Centrex Market

Company:	All
Product:	Centrex Services
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Total Centrex

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	682	722	758	807	861	6.0
Average End-User Price ($K)	NA	NA	NA	NA	NA	-
End-User Revenue ($M)	1166	1179	1201	1236	1350	3.7

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
1991-1995						
Shipments (K)	928	1010	1106	1223	1368	10.2
Average End-User Price ($K)	NA	NA	NA	NA	NA	-
End-User Revenue ($M)	1437	1490	1560	1670	1780	5.5

NA = Not available
Source: Dataquest (October 1991)

Local Telephone Services

Local telephone services include the following:

- Plain old telephone service (POTS)
- Access to long distance networks
- Connections from customer premises equipment to private lines
- Tie lines between separate business locations of an organization

Table 2
Estimated Revenue by Telco
(Billions of Dollars)

Company:	All
Product:	Local Telephone Service
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Revenue by Telco

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total Local Service	74.4	76.3	77.9	79.7	82.0	2.5
Regional Holding Company	57.6	58.7	59.8	60.4	61.4	1.6
Independent Telephone Company	16.8	17.6	18.1	19.3	20.6	5.2

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Total Local Service	85.2	88.0	91.2	94.6	98.0	3.6
Regional Holding Company	62.9	64.5	66.9	69.0	71.5	3.3
Independent Telephone Company	22.3	23.5	24.3	25.6	26.5	4.4

Source: Dataquest (October 1991)

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Long Distance Telephone Services

Table 3
Estimated Long Distance Services Revenue
(Billions of Dollars)

Company:	All
Product:	Long Distance Telephone Service
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Total Services

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total Services	47.7	46.9	50.0	54.1	56.1	4.1

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Total Services	58.5	61.5	64.7	68.1	70.2	4.7

Source: Dataquest (October 1991)

The suppliers of long distance telephone services have the following market shares:

- AT&T—68 percent
- MCI—14 percent
- Sprint—9 percent
- Others—9 percent

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Equipment

The largest portion of the telecommunications equipment sold in the United States is located on the customer premises and includes the following equipment types:

- Automatic call distributors
- Facsimile equipment
- Interactive voice response
- Key telephone systems
- Local area networks
- Modems
- PBX
- T-1 multiplexers
- Videoconferencing systems
- Voice messaging systems

The remaining portion of the telecommunications equipment sold in the United States is in the category of public communications and includes the following equipment types:

- Cellular
- Central office switching equipment
- Packet switching
- Transmission

Automatic Call Distributors

Table 4
Estimated Total Automatic Call Distributor Equipment

Company:	All
Product:	Automatic Call Distributor
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Total by Systems

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	2.8	3.2	4.5	4.9	5.4	17.8
Average End-User Price ($K)	83.5	83.9	85.9	118.6	92.9	2.7
End-User Revenue ($M)	233.4	264.6	388.2	577.3	497.1	20.8

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	6.1	7.0	7.9	8.9	9.9	12.9
Average End-User Price ($K)	85.3	84.3	83.3	82.5	81.9	-1.0
End-User Revenue ($M)	524.1	588.3	655.1	730.8	814.8	11.7

Source: Dataquest (October 1991)

The suppliers of automatic call distributors have the following market shares:

- AT&T—29 percent
- Northern Telecom—23 percent
- IBM/ROLM—15 percent
- Others—33 percent

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Cellular

Table 5
Estimated Total Cellular Revenue
(Millions of Dollars)

Company: All
Product: Cellular
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: By Product Segmentation

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total Cellular	728	973	1202	1740	2087	30.1
Base Station	404	555	590	620	640	12.2
Telephone Handsets	324	418	612	1120	1447	45.4

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Total Cellular	2498	2943	3306	3789	4683	17.0
Base Station	710	750	840	960	1050	10.3
Telephone Handsets	1788	2193	2466	2829	3633	19.4

Source: Dataquest (October 1991)

Table 6
Estimated Telephone Handset Market

Company: All
Product: Cellular
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: All Telephone Handsets

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Placements (K)	360	559	872	1625	2250	58.1
Average End-User Price ($)	900	748	702	689	643	-8.1
End-User Revenue ($M)	324	418	612	1120	1447	45.4

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Placements (K)	2860	3670	4240	5190	6950	24.9
Average End-User Price ($)	625	598	577	545	523	-4.4
End-User Revenue ($M)	1788	2193	2446	2829	3633	19.4

Source: Dataquest (October 1991)

The suppliers of telephone handsets have the following market shares:

- Motorola—15 percent
- Novatel—10 percent
- Uniden—9 percent
- Others—66 percent

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Central Office Switching Equipment

Table 7
Estimated Central Office Switching Equipment Market

Company:	All
Product:	Central Office Switching Equipment
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Total by Lines

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (M)	14.0	13.8	11.6	11.5	11.2	-5.3
Average End-User Price ($)	200	195	192	187	185	-1.9
End-User Revenue ($M)	2800	2690	2227	2142	2079	-7.2

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (M)	11.2	11.4	11.6	12.0	12.3	2.4
Average End-User Price ($)	190	192	195	198	205	1.9
End-User Revenue ($M)	2128	2189	2262	2376	2522	4.3

Source: Dataquest (October 1991)

The suppliers of central office switching equipment have the following market shares:

- Northern Telecom—41 percent
- AT&T—40 percent
- AG Comm. Sys.—8 percent
- Others—11 percent

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Facsimile Equipment

Table 8
Estimated Facsimile Equipment
(Millions of Dollars)

Company: All
Product: Total Facsimile Equipment
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: By Product Segment

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total Fax	503	999	1797	2279	2184	44.4
Group III	502	994	1773	2218	2079	42.6
Group IV	1	5	7	13	8	68.2
PC Fax Boards and Chips	NA	NA	17	48	98	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Total Fax	2337	2481	2858	3356	3829	13.1
Group III	2137	2147	2268	2264	2288	1.7
Group IV	13	20	33	59	79	57.0
PC Fax Boards and Chips	187	314	557	1032	1462	67.3

NA = Not available
Source: Dataquest (October 1991)

Table 9
Estimated Group III Facsimile Market

Company: All
Product: Facsimile Equipment
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Group III

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	NA	1039	1436	1404	-
Average End-User Price ($K)	NA	NA	1.7	1.5	1.5	-
End-User Revenue ($M)	502	994	1773	2218	2079	42.6

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	1466	1500	1580	1592	1614	2.4
Average End-User Price ($K)	1.5	1.4	1.4	1.4	1.4	-0.7
End-User Revenue ($M)	2137	2147	2268	2264	2288	1.7

NA = Not available
Source: Dataquest (October 1991)

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Table 10
Estimated Group IV Facsimile Market

Company:	All
Product:	Facsimile Equipment
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Group IV

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	NA	.6	1.2	.7	-
Average End-User Price ($K)	NA	NA	11.7	10.8	11.2	-
End-User Revenue ($M)	1.0	5.0	7.0	13.0	8.0	68.2

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	1.3	2.0	3.5	6.5	9.3	65.2
Average End-User Price ($K)	10.4	10.0	9.4	9.1	8.5	-4.9
End-User Revenue ($M)	13.0	20.0	33.0	59.0	79.0	57.0

NA = Not available
Source: Dataquest (October 1991)

The suppliers of facsimile equipment have the following market shares:

- Sharp—23 percent
- Murata—19 percent
- Canon—10 percent
- Ricoh—8 percent
- Panasonic—7 percent
- Others—33 percent

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Interactive Voice Response

Table 11
Estimated Total Voice Response Market

Company:	All
Product:	Interactive Voice Response
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Total Voice Response

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	10	13	16	20	25	27.4
Average End-User Price ($K)	59	58	57	56	54	-2.5
End-User Revenue ($M)	570	756	940	1136	1358	24.3

Source: Dataquest (October 1991)

The suppliers of interactive voice response equipment have the following market shares:

- Syntellect—11 percent
- AT&T—9 percent
- Intervoice—6 percent
- Perception Technology—4 percent
- Others—70 percent

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Key Telephone Systems

Table 12
Estimated Total Key Telephone Market

Company:	All
Product:	Key Telephone Systems
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Total by Systems

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	499	481	476	473	479	-1.0
Average End-User Price ($K)	4.9	4.9	4.6	4.3	4.2	-3.9
End-User Revenue ($M)	2460	2355	2184	2056	2012	-4.9

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	485	492	501	511	521	1.8
Average End-User Price ($K)	4.1	4.0	3.9	3.8	3.7	-2.5
End-User Revenue ($M)	1984	1967	1952	1938	1928	-0.7

Source: Dataquest (October 1991)

The suppliers of key telephone systems have the following market shares:

- AT&T—27 percent
- TIE/Communications—12 percent
- Northern Telecom—10 percent
- Executone—9 percent
- Toshiba—7 percent
- Others—35 percent

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Local Area Networks (LANs)

Table 13
Estimated Local Area Networks
(Millions of Dollars)

Company: All
Product: Local Area Network
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Revenue by Product Segment

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total LANs	0	0	0	1895	2739	-
PC LAN	NA	NA	NA	1412	1812	-
Network Interface Cards	NA	NA	NA	998	1124	-
Ethernet	NA	NA	NA	418	515	-
Token-Ring	NA	NA	NA	479	517	-
Others	NA	NA	NA	101	92	-
Network Operating Software	NA	NA	NA	414	688	-
Enterprise LAN	NA	NA	NA	483	928	-
Terminal Servers	NA	NA	NA	261	260	-
Wiring Centers	NA	NA	NA	NA	381	-
FDDI	NA	NA	NA	NA	45	-
LAN Internetworking	NA	NA	NA	222	242	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Total LANs	3308	4008	4839	5578	5882	15.5
PC LAN	2111	2440	2660	2788	2842	7.7
Network Interface Cards	1366	1651	1865	1993	2050	10.7
Ethernet	690	864	983	1045	1073	11.6
Token-Ring	587	703	804	878	918	11.8
Others	89	84	79	69	60	-9.4
Network Operating Software	745	788	796	795	792	1.5
Enterprise LAN	1197	1568	2178	2791	3040	26.2
Terminal Servers	237	192	147	102	80	-23.8
Wiring Centers	545	717	865	1016	1156	20.7
FDDI	124	324	775	1255	1344	81.5
LAN Internetworking	292	336	392	417	459	12.0

NA = Not available
Source: Dataquest (October 1991)

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Table 14
Estimated Network Interface Card Market

Company: All
Product: Network Interface Card
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Total Connections

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	NA	NA	2511	3216	-
Average End-User Price ($)	NA	NA	NA	397	349	-
End-User Revenue ($M)	NA	NA	NA	998	1124	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	4513	5999	7235	8060	8659	17.7
Average End-User Price ($)	303	275	258	247	237	-6.0
End-User Revenue ($M)	1366	1651	1865	1993	2050	10.7

NA = Not available
Source: Dataquest (October 1991)

Table 15
Estimated Ethernet Network Interface Card Market

Company: All
Product: Network Interface Card
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Ethernet Connections

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	NA	NA	1202	1846	-
Average End-User Price ($)	NA	NA	NA	348	279	-
End-User Revenue ($M)	NA	NA	NA	418	515	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	2751	3741	4527	5070	5476	18.8
Average End-User Price ($)	251	231	217	206	196	-6.0
End-User Revenue ($M)	690	864	983	1045	1073	11.6

NA = Not available
Source: Dataquest (October 1991)

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Table 16
Estimated Token-Ring Network Interface Card Market

Company: All
Product: Network Interface Card
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Token-Ring Connections

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	NA	NA	764	832	-
Average End-User Price ($)	NA	NA	NA	627	621	-
End-User Revenue ($M)	NA	NA	NA	479	517	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	1181	1666	2115	2433	2676	22.7
Average End-User Price ($)	497	422	380	361	343	-8.8
End-User Revenue ($M)	587	703	804	878	918	11.8

NA = Not available
Source: Dataquest (October 1991)

Table 17
Estimated Other Network Interface Card Market

Company: All
Product: Network Interface Card
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Other Connections

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	NA	NA	545	538	-
Average End-User Price ($)	NA	NA	NA	185	172	-
End-User Revenue ($M)	NA	NA	NA	101	92	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	581	592	593	557	507	-3.3
Average End-User Price ($)	153	142	132	124	118	-6.3
End-User Revenue ($M)	89	84	79	69	60	-9.4

NA = Not available
Source: Dataquest (October 1991)

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Table 18
Estimated Terminal Server Market

Company:	All
Product:	Terminal Server
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	NA	NA	1161	1230	-
Average End-User Price ($)	NA	NA	NA	225	211	-
End-User Revenue ($M)	NA	NA	NA	261	260	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	1280	1180	1025	860	721	-13.4
Average End-User Price ($)	185	163	143	119	111	-12.0
End-User Revenue ($M)	237	192	147	102	80	-23.8

NA = Not available
Source: Dataquest (October 1991)

Table 19
Estimated Wiring Center Access Market

Company:	All
Product:	Enterprise LAN
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Wiring Center

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	NA	NA	NA	1270	-
Average End-User Price ($)	NA	NA	NA	NA	300	-
End-User Revenue ($M)	NA	NA	NA	NA	381	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	1972	2747	3521	4371	5216	27.5
Average End-User Price ($)	276	261	245	232	222	-5.4
End-User Revenue ($M)	545	717	865	1016	1156	20.7

NA = Not available
Source: Dataquest (October 1991)

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Table 20
Estimated Revenue by FDDI Segment
(Millions of Dollars)

Company: All
Product: FDDI
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Revenue by FDDI Segment

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total FDDI	NA	NA	NA	NA	45	-
NIC	NA	NA	NA	NA	16	-
Internetworking	NA	NA	NA	NA	27	-
Concentrator	NA	NA	NA	NA	2	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Total FDDI	124	324	775	1255	1344	81.5
NIC	77	226	640	1102	1146	96.6
Internetworking	39	73	97	110	112	30.3
Concentrator	8	25	38	43	85	80.5

NA = Not available
Source: Dataquest (October 1991)

The suppliers of network interface cards have the following market shares:

- IBM—20 percent
- 3Com—18 percent
- Western Digital—12 percent
- Anthem Electronics—7 percent
- Others—43 percent

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Modems

Table 21
Estimated Total Modem Market

Company: All
Product: Modem
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Total Modems

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	2157	2447	2917	3050	-
Average End-User Price ($)	NA	603	516	381	333	-
End-User Revenue ($M)	1243	1300	1262	1111	1015	-4.9

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	3563	4001	4277	4460	4565	6.4
Average End-User Price ($)	261	206	148	111	80	-25.5
End-User Revenue ($M)	931	824	633	495	367	-20.8

NA = Not available
Source: Dataquest (October 1991)

Table 22
Estimated V.32 Modem Market

Company: All
Product: Modem
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: V.32

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	NA	20	48	100	235	-
Average End-User Price ($)	NA	1500	1388	1100	900	-
End-User Revenue ($M)	NA	30	67	110	211	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	490	750	940	1100	1200	25.1
Average End-User Price ($)	695	550	400	300	200	-26.8
End-User Revenue ($M)	341	413	376	330	240	-8.4

NA = Not available
Source: Dataquest (October 1991)

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Table 23
Estimated Total Modem Market
(Thousands of Units)

Company:	All
Product:	Modem
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Total Modems

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total Modems	NA	2157	2447	2917	3050	-
212A	NA	818	848	855	830	-
201 B/C	NA	135	92	80	50	-
v.22bis	NA	716	1015	1480	1548	-
208 A/B	NA	182	130	110	75	-
V.29	NA	191	191	160	140	-
V.32	NA	20	48	100	235	-
V.33	NA	37	41	43	37	-
16.8-Kbps	NA	2	4	3	3	-
19.2-Kbps	NA	9	14	14	13	-
9.6-Kbps Dial-Up	NA	47	64	72	120	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Total Modems	3563	4001	4277	4460	4565	6.4
212A	820	800	750	725	675	-4.7
201 B/C	40	35	30	20	15	-21.7
v.22bis	1900	2185	2400	2500	2600	8.2
208 A/B	60	50	35	25	17	-27.0
V.29	110	75	50	35	25	-31.0
V.32	490	750	940	1100	1200	25.1
V.33	28	19	12	8	7	-29.3
16.8-Kbps	3	2	2	1	1	-24.8
19.2-Kbps	12	10	8	6	5	-19.7
9.6-Kbps Dial-Up	100	75	50	40	20	-33.1

NA = Not available
Source: Dataquest (October 1991)

The suppliers of modems have the following market shares:

- Codex (Motorola)—13 percent
- Racal/Milgo—11 percent
- UDS (Motorola)—11 percent
- Hayes—10 percent
- IBM—8 percent
- Others—47 percent

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Packet Switching

Table 24
Estimated Packet Switching Revenue
(Millions of Dollars)

Company:	All
Product:	Packet Switching
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	By Product Segment

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Packet Switches	NA	NA	266	287	302	-
Nodes	NA	NA	164	176	184	-
Switches	NA	NA	56	58	60	-
Pads	NA	NA	46	53	58	-

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Packet Switches	317	321	310	294	271	-3.8
Nodes	190	190	181	169	153	-5.3
Switches	64	65	62	58	54	-4.1
Pads	63	66	68	67	64	0.6

NA = Not available
Source: Dataquest (October 1991)

The suppliers of packet switching equipment have the following market shares:

- Northern Telecom—24 percent
- Telenet—13 percent
- Tymnet—9 percent
- Hughes—8 percent
- Others—46 percent

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PBX Systems

Table 25
Estimated Total PBX Market (Systems)

Company: All
Product: PBX Systems
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Total PBX Systems

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	33	31	32	31	27	-5.0
Average End-User Price ($K)	96	101	97	94	99	0.8
End-User Revenue ($M)	3157	3103	3119	2904	2653	-4.3

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	29	30	32	34	37	6.1
Average End-User Price ($K)	88	85	82	81	78	-2.7
End-User Revenue ($M)	2539	2553	2649	2756	2875	3.2

Source: Dataquest (October 1991)

Table 26
Estimated Total PBX Market (New Lines)

Company: All
Product: PBX Systems
Region of Consumption: North America
Distribution Channel: All
Application: All
Specification: Total New Lines

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	5000	5301	5615	5267	5050	0.2
New	4300	4330	4404	4158	3847	-2.7
Add-On	700	971	1211	1109	1203	14.5
Average End-User Price ($)	734	717	708	698	689	-1.6
End-User Revenue ($M)	3157	3103	3119	2904	2653	-4.3

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	4925	5122	5350	5590	5847	4.4
New	3746	3791	3959	4137	4332	3.7
Add-On	1180	1331	1391	1453	1515	6.5
Average End-User Price ($)	678	673	669	666	664	-0.5
End-User Revenue ($M)	2539	2553	2649	2756	2875	3.2

Source: Dataquest (October 1991)

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The suppliers of PBX systems have the following market shares:

- AT&T—27 percent
- Northern Telecom—22 percent
- ROLM—14 percent
- Mitel—6 perent
- Others—31 percent

T-1 Multiplexers

Table 27
Estimated Total T-1 Multiplexer Market

Company:	All
Product:	T-1 Multiplexers
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	6	7	8	11	13	20.6
Average End-User Price ($K)	40	46	46	39	34	-3.9
End-User Revenue ($M)	241	309	388	446	434	15.9

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	15	19	24	29	35	23.0
Average End-User Price ($K)	28	23	19	15	12	-18.3
End-User Revenue ($M)	432	436	442	443	441	0.5

Source: Dataquest (October 1991)

The suppliers of T-1 multiplexers have the following market shares:

- Timeplex—21 percent
- Net—19 percent
- Newbridge—13 percent
- GDC—7 percent
- Others—40 percent

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Transmission Equipment

Table 28
Estimated Transmission Equipment Revenue
(Millions of Dollars)

Company:	All
Product:	Transmission Equipment
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
All Transmission Equipment	1934	2203	2422	2589	2990	11.5
Fiber-Optic Equipment	479	695	827	919	1134	24.0
Sonet Equipment	0	0	6	15	35	-
Digital Non-Fiber-Optic Eqp	1455	1508	1595	1670	1856	6.3

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
All Transmission Equipment	3373	3604	3943	4361	4505	7.5
Fiber-Optic Equipment	1377	1581	1891	2220	2550	16.7
Sonet Equipment	78	161	379	647	1025	90.3
Digital Non-Fiber-Optic Eqp	1996	2023	2052	2141	1955	-0.5

Source: Dataquest (October 1991)

The top suppliers of transmission equipment include the following:

- AT&T
- DSC
- Tellabs
- Rockwell
- Northern Telecom

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Videoconferencing

Table 29
Estimated Videoconferencing Market

Company:	All
Product:	Videoconferencing
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	.3	.5	.8	1.6	2.4	68.2
Average End-User Price ($K)	66.4	47.8	37.3	42.2	42.3	-10.7
End-User Revenue ($M)	17.3	24.4	31.0	69.0	103.6	56.4

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	3.5	5.0	6.8	8.9	11.1	33.4
Average End-User Price ($K)	40.9	39.0	37.1	35.5	33.8	-4.7
End-User Revenue ($M)	145.1	193.7	250.7	314.8	373.3	26.6

Source: Dataquest (October 1991)

The top suppliers of video teleconferencing systems include the following companies:

- Compression Labs—36 percent
- PictureTel—33 percent
- GPT—13 percent
- Video Telecom—13 percent
- Others—5 percent

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Voice Messaging Systems

Table 30
Estimated Total Voice Messaging Market

Company:	All
Product:	Voice Messaging Systems
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	Total by Systems

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Shipments (K)	2	7	14	20	23	82.4
Average End-User Price ($K)	83	40	32	28	34	-19.8
End-User Revenue ($M)	171	285	432	563	782	46.2

	1991	1992	1993	1994	1995	CAGR (%) 1991-1995
Shipments (K)	26	30	34	38	42	12.5
Average End-User Price ($K)	33	32	31	29	28	-3.9
End-User Revenue ($M)	870	968	1034	1103	1187	8.1

Source: Dataquest (October 1991)

The suppliers of voice messaging systems have the following market shares:

- Octel—20 percent
- AT&T—14 percent
- Northern Telecom—12 percent
- ROLM—10 percent
- Others—44 percent

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0011497

Market Statistics
Industrial Electronics—North America
1990

Source:
Dataquest

Semiconductor Application Markets *Worldwide*

Dataquest

Market Statistics
Industrial Electronics—North America
1990

Source: Dataquest

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Industrial Application Segment

This section profiles the market size and the major companies of the Industrial application segment in North America. The companies are listed in alphabetical order, not in rank order.

Figure 1 shows the breakdown of the major categories in the Industrial segment. Figures 2 and 3 further illustrate two major categories in the Industrial segment.

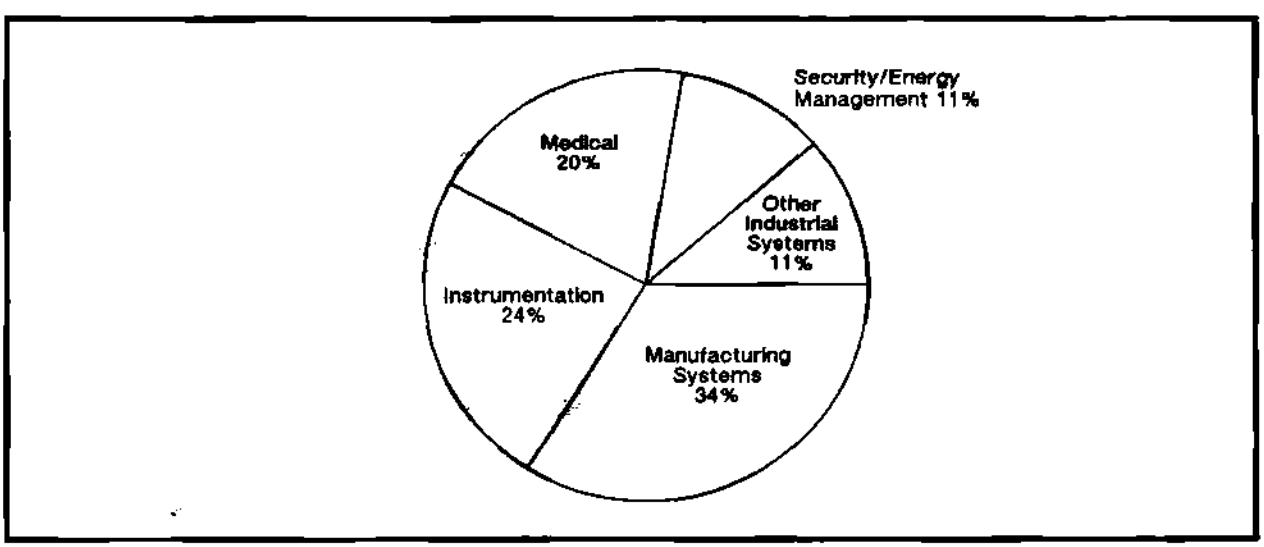
Tables 1 through 11 show the estimated total value of equipment production for each category in millions of dollars. Some table columns do not add to totals shown because of rounding.

Security/Energy Management

The following is a sample of major companies participating in the security/energy management arena:

- Security
  - Alarm Device Manufacturing
  - Cerberus Pyrotronics
  - EyeDentify Inc.

Figure 1
North American Industrial Electronic Equipment Production (1990)



Source: Dataquest (April 1991)

Table 1
North America Electronic Equipment Production
Security/Energy Management
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989	1990*
Intrusion detection	516	568	590	679	781	752	804	875
Fire detection	364	477	431	427	436	413	477	532
Alarm systems subtotal	880	1,045	1,021	1,106	1,217	1,165	1,281	1,407
Energy management	1,894	1,870	1,878	1,964	2,093	2,168	2,209	2,284
Total	2,774	2,915	2,899	3,070	3,310	3,333	3,490	3,691

*Preliminary estimate
Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

- Honeywell Inc.
- Johnson Controls Inc.
- Simplex Time Recorder Co.
- Wells Fargo Alarm Services

• Energy

- Carrier Corporation
- Emerson Electric
- Honeywell/Building Controls Division
- Joy Technologies
- Scientific Atlanta Inc./Control Systems Business Division
- Solid State Systems
- Trane Co.
- Westinghouse/Energy Systems

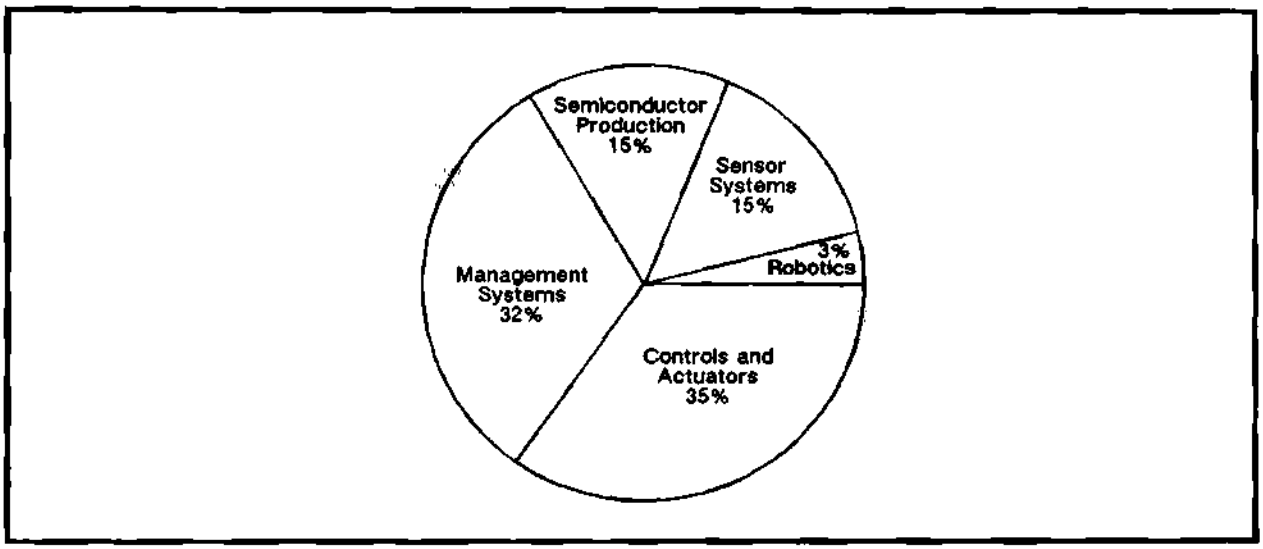
Manufacturing Systems

The following is a sample of the major companies participating in the manufacturing systems market:

• Semiconductor production

- Anelva (sputtering, dry etch, molecular beam epitaxy, evaporation, LPCVD, PECVD, ECR CVD)
- Applied Materials (dry etch, silicon epitaxy, APCVD, PECVD, LPCVD, ion implantation)
- ASM Lithography (steppers, direct write and maskmaking)
- ASM International (diffusion, LPCVD, PECVD, silicon epitaxy)
- Canon (projection aligners, steppers, contact/proximity, resist processing equipment, optical CD/wafer inspection)
- Dainippon Screen (resist processing equipment, wet process, rapid thermal processing)
- Eaton (ion implantation, resist processing equipment, steppers, rapid thermal processing)
- General Signal (steppers, resist processing equipment, dry etch, dry strip, diffusion, LPCVD, APCVD, sputtering)
- Hitachi (direct write and maskmaking, steppers, dry etch, dry strip, ion implantation, optical CD/wafer inspection, APCVD)
- Lam Research (dry etch, silicon epitaxy)
- Nikon (steppers, optical CD/wafer inspection)
- Silicon Valley Group (resist processing equipment, diffusion, LPCVD)

Figure 2
North American Manufacturing Systems Production (1990)



Source: Dataquest (April 1991)

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Table 2
North American Electronic Equipment Production
Manufacturing Systems
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989	1990*
Semiconductor production	908	1,461	1,258	1,077	1,105	1,541	1,696	1,691
Controls and actuators	2,776	3,347	3,152	3,258	3,346	3,655	3,895	3,985
Sensor systems	1,055	1,211	1,339	1,241	1,350	1,511	1,640	1,765
Management systems	2,356	2,736	2,919	3,178	3,197	3,405	3,570	3,684
Robotics	232	281	345	346	284	229	256	274
Total	7,327	9,036	9,013	9,100	9,282	10,341	11,057	11,399

*Preliminary estimate
Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

Table 3
North American Electronic Equipment Production
Controls and Actuators
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989
AC full-voltage starters	326	350	314	386	401	390	395
Motor control centers	242	251	282	262	243	251	255
Starters and contactors for motor	81	47	50	50	44	52	55
Pilot circuit devices	200	306	271	324	363	401	425
Push buttons, rheostats, and resist	267	319	282	301	305	342	370
Metal mills	189	161	161	179	176	205	225
Crane and hoist controls	20	28	27	20	26	28	30
Adjustable-speed drives	246	321	353	382	441	514	565
Numerical controls	599	910	844	816	741	808	875
Other controls	606	655	568	538	606	663	700
Total	2,776	3,348	3,152	3,258	3,346	3,654	3,895

Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

Table 4
North American Electronic Equipment Production
Sensor Systems
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989
Temperature	97	131	138	129	181	174	170
Pressure, draft, and vacuum	128	155	169	169	185	210	230
Flow and liquid level	508	585	624	594	629	703	765
Humidity instruments	16	19	19	19	24	27	30
Continuous process gas and liquid analysis	221	230	273	233	238	278	310
Instruments for other variables (speed, viscosity, position, density, specific gravity)	84	92	117	99	93	118	135
Total	1,054	1,212	1,340	1,243	1,350	1,510	1,640

Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

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Table 5
North American Electronic Equipment Production Management Systems
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989
Electronic Systems (unified architecture type)							
Controllers	145	109	92	105	106	121	130
Recorders	66	76	77	71	92	124	150
Indicators	33	27	41	35	37	40	45
Electronic systems (nonunified architecture type)	441	652	706	690	778	869	935
Multifunction process computers	171	144	135	154	178	181	185
Pneumatic systems	79	62	66	61	60	71	80
Annunciators	13	21	37	39	22	26	30
Physical properties testing and inspection equipment	365	395	409	494	534	565	590
Kinematic test and measuring equipment	129	164	113	130	149	150	150
Automatic regulating devices	505	508	622	609	515	566	600
Other process instruments	410	579	622	792	727	692	675
Total	2,357	2,737	2,920	3,180	3,198	3,405	3,570

Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

Table 6
North American Electronic Equipment Production Robotics
(Millions of Dollars)

Equipment	1984	1985	1986	1987	1988	1989
Servo-controlled robots						
Point-to-point type	119	142	157	136	107	134
Continuous-path type	87	113	99	67	59	47
Non-servo-controlled	16	18	16	8	17	22
Other robots, including educational, hobby, and experimental	3	3	3	9	9	13
Robot accessories, subassemblies, components, and parts sold separately	40	52	57	49	57	74
Sensors	15	18	15	16	18	25
Total	280	346	347	285	267	315

Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

- Tokyo Electron Limited (resist processing equipment, diffusion, LPCVD, dry etch, metalorganic CVD, rapid thermal processing)
- Ulvac (sputtering, evaporation, ion implantation, molecular beam epitaxy, PECVD, LPCVD, dry etch, dry strip, metalorganic CVDE)
- Varian Associated (sputtering, ion implantation, molecular beam epitaxy, dry etch, LPCVD, rapid thermal processing, direct write and mask-making)

• Other manufacturing systems

- Allen-Bradley (data acquisition, manufacturing process controls, programmable controls, machine tools/presses, inspection equipment)

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- Bailey Controls Company (manufacturing process controls, other manufacturing control systems)
- Cincinnati Milacron (manufacturing process controls, programmable controls for machine and factory process, FMS materials handling equipment, machine tool accessories/tools)
- Fisher Controls (manufacturing process controls)
- Fisher & Porter Co. (manufacturing process controls)
- General Electric (data acquisition/ID equipment, manufacturing process controls, programmable controls for machines and factory processes)
- Johnson Controls (manufacturing process controls)
- Leeds & Northrup Co. (manufacturing process controls, programmable controls for machines, other material handling/shipping equipment)
- Modicon (data acquisition/ID equipment, manufacturing process controls, programmable controls for machines and factory processes)
- Texas Instruments (manufacturing process controls)
- Westinghouse (data acquisition/ID equipment, manufacturing process controls, other manufacturing control systems, container systems, machine tools/presses)

- Robotics
  - Adept Technology
  - ASEA Brown Boveri Robotics, Inc.
  - Automatix Inc.
  - Cimflex Teknowledge Corp.
  - Fisher Scientific Group
  - GE Factory Automation
  - Graco Robotics
  - Intelledex

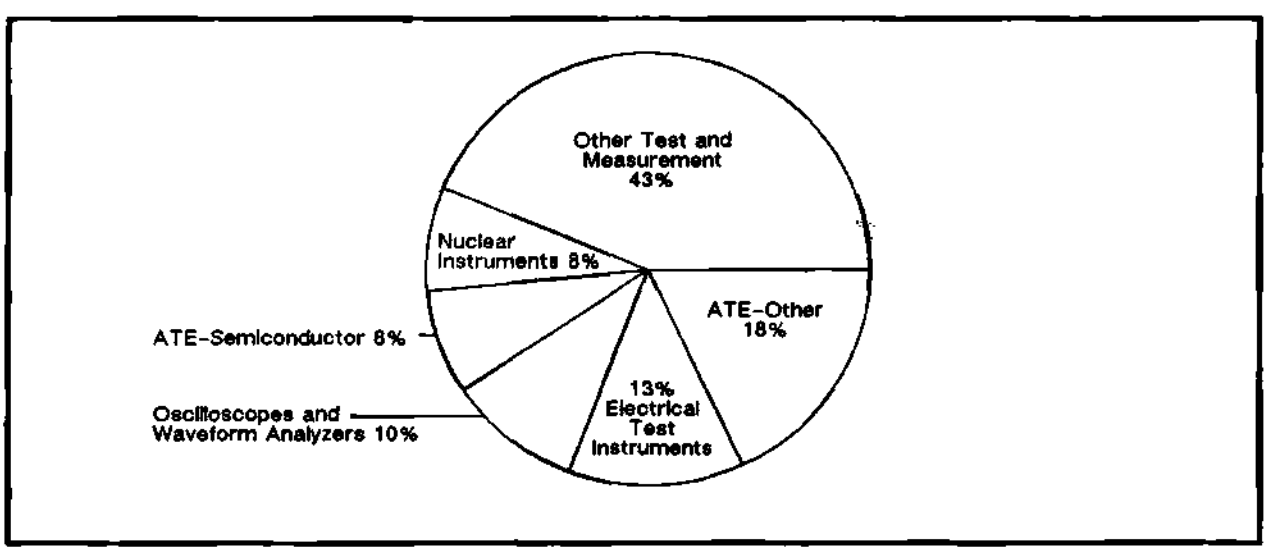
Adept Technology, ASEA Brown Boveri, Cimflex Teknowledge, and GE Factory Automation also produce vision systems.

Instrumentation

The following is a sample of the major companies participating in the electronic instrumentation category:

- Automatic Test Equipment
  - Advantest
  - Asia Electronics
  - Credence

Figure 3
North American Instrumentation Electronic Equipment Production (1990)



Source: Dataquest (April 1991)

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Table 7
North American Electronic Equipment Production
Instrumentation
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989	1990*
ATE—semiconductor	247	476	470	460	565	583	635	616
ATE—other	941	940	954	994	1,379	1,379	1,517	1,547
Oscilloscopes & waveform analyzers	678	739	744	679	658	714	785	836
Nuclear instruments	490	480	519	560	601	614	625	636
Electrical test instruments	1,197	1,450	1,268	1,251	1,074	980	1,003	1,029
Other test & measurement	2,524	3,157	3,094	2,875	2,938	3,075	3,295	3,509
Total	6,076	7,242	7,049	6,819	7,214	7,345	7,860	8,173

*Preliminary estimate
Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

Table 8
North American Electronic Equipment Production
Electrical Test Instruments
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989
Voltage, current, and resistance measuring equipment	229	270	276	261	302	286	295
Multimeters	104	127	133	127	136	131	135
Power and energy measuring equipment	54	59	80	101	98	77	75
Frequency measuring	109	114	137	124	112	104	100
Signal-generating equipment	328	351	315	325	357	312	325
Field strength and intensity measuring	155	211	249	231	NA	NA	NA
Impedance and standing wave ratio measuring	36	54	44	49	48	54	60
X-Y plotters	183	263	34	34	19	16	13
Total	1,198	1,449	1,268	1,252	1,074	980	1,003

NA = Not available
Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

- GenRad
- Hewlett-Packard
- LTX
- Megatest
- Minato
- Schlumberger
- Tektronix
- Teradyne

• Electrical Test Instruments

- Analogic Corporation (oscilloscopes)
- Ametek Inc. (infrared analyzers, calibrators, data logging/acquisition, flow measuring equipment, level measuring equipment)
- EG&G (data recorders, oscilloscopes, detection equipment, seismograph measuring equipment, geophysical measuring equipment, flow measuring equipment, frequency measuring equipment, other measuring equipment, spectrometers)
- Fisher Controls (electronic function controls)
- Gould (computer-related analyzers, oscilloscopes, data logging/acquisition equipment, data recorders, waveform analyzers)

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Table 9
North American Electronic Equipment Production
Other Test and Measurement
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989
AC watt-hour meters	179	181	197	186	183	158	150
Combined watt-hour and demand meters and time-switch meters	75	85	94	103	101	119	135
Other integrating meters and instruments, and parts	104	152	111	114	116	116	120
Standards and calibration	133	131	184	145	186	170	175
Microwave test	34	36	34	35	47	57	70
Communications test	39	178	263	259	363	444	525
Internal combustion engine analyzer	232	307	312	296	274	281	300
Associated devices for testing and measuring	118	225	NA	NA	NA	NA	NA
Other test, measuring, and analyzer	1,225	1,379	1,379	1,214	1,063	1,038	1,035
Geophysical and meteorological	224	315	332	319	358	414	454
Survey and drafting instruments	162	167	188	204	247	279	331
Total	2,525	3,156	3,094	2,875	2,938	3,075	3,295

NA = Not available
Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

- Hewlett-Packard (oscilloscopes, bar code readers, analyzers, counters/timers, data recorders, multimeters, power measuring equipment, spectrophotometers)
- John Fluke (oscilloscopes, analyzers, counters/timers, voltmeters)
- LeCroy Corporation (oscilloscopes)
- IFR Systems (oscilloscopes)
- Millipore/Chromatography Division (scientific instruments, counter/recorders)
- Nicolet (oscilloscopes, mass spectrometers)
- Schlumberger (indicators, power measuring equipment, electrical measuring equipment, geophysical measuring equipment, oscilloscopes, analyzers, data logging/acquisition equipment)
- Teledyne (chemical/physical analyzers, infrared analyzers, other analyzers, calibrators, energy fuel retrieval equipment, geophysical equipment, seismograph measuring equipment, voltmeters)
- Tektronix (oscilloscopes, analyzers, calibrators)
- Tracor, Inc. (analyzers, data recorders, detection equipment, spectroscopy equipment, spectrophotometers)
- Westinghouse (data recorders, detection equipment, measuring equipment, electronic function controls)

Medical

The following is a sample of major companies participating in the medical electronics arena:

- Abbot Laboratories
- Acuson
- Bard (CR)
- Baxter International
- Becton, Dickson
- Diasonics
- Medtronic
- General Electric
- GEC, U.K.
- Siemens
- Philips
- Hitachi
- Toshiba

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Table 10
North American Electronic Equipment Production
Medical Equipment
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989	1990*
X-ray	1,514	1,758	1,675	1,606	1,571	1,658	1,725	1,756
Ultrasonic & scanning	376	294	172	244	337	311	320	329
Blood and body fluid analyzers	744	715	632	572	617	595	605	618
Other Diagnostic	476	511	588	565	935	1,048	1,160	1,278
Diagnostic subtotal	3,110	3,278	3,067	2,987	3,460	3,612	3,810	3,981
Patient-monitoring equipment	298	280	352	302	284	296	305	313
Other Therapeutic	1,407	1,590	1,609	1,643	1,832	2,075	2,240	2,386
Therapeutic subtotal	1,705	1,870	1,961	1,945	2,116	2,371	2,545	2,699
Total	4,815	5,148	5,028	4,932	5,576	5,983	6,355	6,680

*Preliminary estimate
Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

Other Industrial

All other industrial systems are combined in Table 11.

Table 11
North American Electronic Equipment Production
Other Industrial Systems
(Millions of Dollars)

Equipment	1983	1984	1985	1986	1987	1988	1989	1990*
Other Industrial Systems	2,625	2,746	2,575	2,622	3,266	3,384	3,625	3,748

*Preliminary estimate
Source: Electronics Industry Association, U.S. Department of Commerce, Dataquest (April 1991)

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Market Statistics

Military Electronics—North America

1990

Source: Dataquest

Semiconductor Application Markets *Worldwide*

Dataquest

Market Statistics

Military Electronics—North America

1990

Source: Dataquest

Published by Dataquest Incorporated

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Market Statistics: Military Electronics—North America 1990

Worldwide Defense Spending

Table 1 presents national defense spending budgets for selected countries.

U.S. Military Electronics

Table 2 presents the Department of Defense (DOD) budget proposal for 1992 and 1993. Table 3 lists the major program termination considerations within the proposal. Likewise, Table 4 describes the proposed restructuring of the armed services.

Table 1
National Defense Spending
(Billions of Dollars)

	1988	1989	1990
United States	284.0	289.0	293.0
United Kingdom	33.8	33.4	33.4
France	30.7	28.6	33.0
Germany	29.2	27.5	31.0
Japan	28.4	28.6	30.1
Italy	16.1	16.7	19.0
Canada	8.8	9.5	10.2

Source: Dataquest (May 1991)

U.S. Defense Programs

Please note that in the following discussion of U.S. defense programs NM denotes not meaningful, P indicates proposed, and A indicates actual budget authority.

Table 5 lists the funding of major electronic intensive programs within the DOD budget.

Aircraft and Avionics

Listed below are some of the more notable electronic-intensive aircraft and avionics programs:

- Advanced Tactical Aircraft (ATF) (U.S. Air Force)
  - Contractor(s)
    - Lockheed-General Dynamics-Boeing (YF-22A)
    - Westinghouse-Texas Instruments (radar)
    - Hughes-Texas Instruments (22A computers)
    - GE (22A electro-optics)
    - Sanders-GE (INEWS electronic warfare)

Table 2
FY1992/FY1993 DOD Budget Proposal
(Current Billions of Dollars)

	FY1990	FY1991	FY1992	FY1993
Military Personnel	78.9	79.0	78.0	77.5
Operations and Maintenance	88.3	86.0	86.5	84.7
Procurement	81.4	64.1	63.4	66.7
RDT&E	36.5	34.6	39.9	41.0
Military Construction	5.1	5.0	4.5	3.7
Family Housing	3.1	3.3	3.6	3.6
Other	-0.3	1.0	2.3	0.7
DOD Total	293.0	273.0	278.2	277.9

Source: U.S. Department of Defense

Table 3
Major Program Terminations (FY1992-FY1993 Budget)
(Billions of Dollars)

	Savings	
	FY1992	FY1993-1997
Bradley Fighting Vehicle	0.7	1.7
Trident Submarine	1.4	2.8
LHD Amphibious Ship	-	2.1
P-7A Antisubmarine Warfare Aircraft	0.6	5.4
F-14D Remanufacture	1.4	13.4
Naval Advanced Tactical Fighter	0.1	2.0
A-12 Aircraft	2.7	19.5
Air Force Advanced Tactical Aircraft	-	0.8
F-16 Aircraft (End of FY93)	1.6	13.8
Peacekeeper Missiles	0.7	2.2
Mark XV Combat Identification System	0.1	0.2
BSTS Warning System	0.4	5.5
Tacit Rainbow Program	0.2	2.3

Source: U.S. Department of Defense

Table 4
Force Restructure

	FY1990	FY1995
Army Divisions	28 (18 active)	18 (12 active)
Aircraft Carriers	13	12
Carrier Air Wings	15 (13 active)	13 (11 active)
Battle Force Ships	545	451
Tactical Fighter Wings	36 (24 active)	26 (15 active)
Strategic Bombers	268	181

Source: U.S. Department of Defense

- Funding
  - 1991A—$995 million/0 units
  - 1992P—$1,637 million/0 units
  - 1993P—$2,325 million/0 units
- Plans
  - 648 units for U.S. Air Force to be produced from 1996 through 2020 to replace the F-15
  - U.S. Navy version proposed

• Light Helicopter (LH) (U.S. Army)

- Contractor(s)
  - Boeing-Sikorsky (primes)
  - Westinghouse (radar, electro-optics)
  - Martin Marietta (targeting)
  - Boeing/Hamilton Standard (computers)
  - Rockwell Collins (communication/ navigation)
  - TRW (electronic warfare)
- Funding
  - 1991A—$340 million/0 units
  - 1992P—$550 million/0 units
  - 1993P—$617 million/0 units
- Plans
  - 1,292 are planned to be purchased by the U.S. Army between 1997 and 2005.
  - Unit cost will be $8.9 million.

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Table 5
50 Major U.S. Procurement Programs
(Millions of Dollars)

	Authorized FY1991 Buy		Requested FY1992 Buy		Requested FY1993 Buy	
	No.	$	No.	$	No.	$
Aircraft						
ATF	0	955	0	1,637	0	2,325
AH-64	0	91	0	145	0	153
CH-47	0	291	0	257	0	24
LH	0	340	0	550	0	617
OH-58D	0	39	0	209	0	95
UH-60L	48	105	60	508	60	428
AH-1W	8	93	12	145	12	142
AV-8B	24	555	0	10	0	11
CH/MH-53E	12	336	20	522	20	531
E-2C	6	466	6	539	6	542
F-14D	0	170	0	116	0	104
F/A-18	48	1,683	36	2,423	20	2,534
B-2	2	4,185	4	4,822	7	4,639
C-17	0	1,026	6	2,831	12	4,212
E-8A JSTARS	0	191	0	397	1	779
F-15	36	1,648	0	309	0	65
F-16	108	2,154	48	1,419	24	923
Ships						
DDG-51	4	3,246	5	4,541	4	3,644
LHD-1	1	972	0	40	0	40
MHC-1	2	212	2	248	2	248
SSN-21	1	2,340	1	2,382	2	2,464
Trident	1	1,352	0	154	0	49
Missiles						
AAWS-M	0	92	0	124	1,647	225
ATACMS	318	192	300	180	351	192
Hellfire	4,200	179	112	38	3,543	178
Patriot	817	759	0	140	0	66
TOW-2	10,946	211	10,000	281	9,440	245
AMRAAM	695	846	1,191	1,031	1,469	1,049
Harpoon	160	243	0	38	0	0
Standard	790	662	525	461	550	463
Tomahawk	400	710	236	500	200	417
Trident II	52	1,671	28	1,271	31	1,380
ACM	85	506	120	626	102	552
AGM-130	48	52	120	93	149	111
HARM	120	34	465	117	901	232
HAVE NAP	26	28	32	37	0	0

(Continued)

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Table 5 (Continued)
50 Major U.S. Procurement Programs
(Millions of Dollars)

	Authorized FY1991 Buy		Requested FY1992 Buy		Requested FY1993 Buy	
	No.	$	No.	$	No.	$
Missiles (Continued)						
MX/Rail Garrison	12	918	0	458	0	106
SRAM-II	0	159	0	177	25	259
Mk-48 ADCAP	240	419	108	367	108	260
Space						
FLTSATCOM	3	250	3	283	0	171
DMSP	1	216	2	162	0	55
DSCS	0	80	0	70	0	30
DSP	1	674	0	273	1	653
MILSTAR	0	956	0	1,404	0	1,536
NAVSTAR	0	282	0	397	0	420
NASP*	0	162	0	232	0	183
SDI	-	2,874	-	4,581	-	4,933
Vehicles						
Bradley M-2	600	647	0	109	0	110
Abrams M-1	225	804	0	79	0	46
HMMWV	8,030	252	7,302	282	6,922	242

*DOD funding only
Source: U.S. Department of Defense

- F-16 Falcon (U.S. Air Force)
  - Contractor(s)
    - General Dynamics (prime)
    - Westinghouse (radar)
    - Teledyne Systems/Bendix (flight computer)
  - Funding
    - 1991A—$2,154 million/108 units
    - 1992P—$1,419 million/48 units
    - 1993P—$923 million/24 units
  - Plans
    - U.S. Air Force purchases will end in 1993.
    - Various upgrades are planned, and several foreign customers have orders.

- F/A-18 Hornet (U.S. Navy)
  - Contractor(s)
    - McDonnell Douglas (prime)
    - Hughes (radar, FLIR)
  - Funding
    - 1991A—$1,683 million/48 units
    - 1992P—$2,423 million/36 units
    - 1993P—$2,534 million/20 units
  - Plans
    - Ongoing, but slowing production of this fighter/bomber for the U.S. Navy
    - R&D funding was increased as a F/A-18 variant is favored to replace the canceled A-12 aircraft

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- C-17 (U.S. Air Force)
  - Contractor(s)
    - McDonnell Douglas (prime)
  - Funding
    - 1991A—$1,026 million/0 units
    - 1992P—$2,831 million/6 units
    - 1993P—$4,212 million/12 units
  - Plans
    - Production of this cargo plane is to begin in 1992.
    - A total of 120 planes are planned for the U.S. Air Force.
- B-2 (U.S. Air Force)
  - Contractor(s)
    - Northrop (prime)
    - Hughes (radar)
    - Unisys (computers)
  - Funding
    - 1991A—$4,185 million/2 units
    - 1992P—$4,822 million/4 units
    - 1993P—$4,639 million/7 units
  - Plans
    - This controversial strategic bomber program is slated for a total of 72 aircraft.
- UH-60L Black Hawk Helicopter (U.S. Army)
  - Contractor(s)
    - United Technologies Sikorsky (prime)
  - Funding
    - 1991A—$105 million/48 units
    - 1992P—$508 million/60 units
    - 1993P—$428 million/60 units
  - Plans
    - Ongoing production with a total of 1,621 units planned

Missile Systems

Listed below are some of the more notable electronic-intensive missile programs:

- AMRAAM (U.S. Air Force and Navy)
  - Contractor(s)
    - Hughes-Raytheon (primes)
  - Funding
    - 1991A—$846 million/695 units
    - 1992P—$1,031 million/1,191 units
    - 1993P—$1,049 million/1,469 units
  - Plans
    - After overcoming initial reliability problems, the program has entered production.
- AAWS-M (U.S. Army)
  - Contractor(s)
    - Texas Instruments-Martin Marietta (primes)
  - Funding
    - 1991A—$92 million/0 units
    - 1992P—$124 million/0 units
    - 1993P—$225 million/1,647 units
  - Plans
    - Currently in development, AAWS-M is slated to replace the Dragon antitank missile.
    - The U.S. Army plans to procure 70,000 missiles over the program's lifetime.

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- TOW-2 (U.S. Army)
  - Contractor(s)
    - Hughes (prime)
    - Texas Instruments (retrofit kits)
  - Funding
    - 1991A—$211 million/10,946 units
    - 1992P—$281 million/10,000 units
    - 1993P—$245 million/9,440 units
  - Plans
    - Ongoing production of this antitank weapon
    - Possible replacement by AAWS-H
- Tomahawk (U.S. Navy)
  - Contractor(s)
    - General Dynamics-McDonnell Douglas (prime)
  - Funding
    - 1991A—$710 million/400 units
    - 1992P—$500 million/236 units
    - 1993P—$417 million/200 units
  - Plans
    - Ongoing production
    - Additional 440 requested to replenish war usage
- Advanced Cruise Missile (ACM) (U.S. Air Force)
  - Contractor(s)
    - General Dynamics-McDonnell Douglas (primes)
  - Funding
    - 1991A—$506 million/85 units
    - 1992P—$626 million/120 units
    - 1993P—$552 million/102 units
  - Plans
    - Ongoing production of this long-range weapon; 1,000 planned
- Hellfire (U.S. Army and Navy)
  - Contractor(s)
    - Rockwell-Martin Marietta (primes)
  - Funding
    - 1991A—$179 million/4,200 units
    - 1992P—$38 million/112 units
    - 1993P—$178 million/3,543 units
  - Plans
    - Ongoing production of this antitank weapon with laser guided upgrade

Shipboard Systems

Listed below are some of the more electronic-intensive ship and submarine programs:

- DDG-51 Arleigh Burke Guided Missile Destroyer (U.S. Navy)
  - Contractor(s)
    - Ingalls Shipbuilding and Bath Iron Works (primes)
    - GE-RCA (AEGIS Air Defense System)
  - Funding
    - 1991A—$3,246 million/4 units
    - 1992P—$4,451 million/5 units
    - 1993P—$3,644 million/4 units
  - Plans
    - Ongoing production with plans for 38 ships

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- SSN-21 Seawolf Attack Submarine (U.S. Navy)
  - Contractor(s)
    - General Dynamics (prime)
    - GE (BSY-2 combat system)
  - Funding
    - 1991A—$2,340 million/1 unit
    - 1992P—$2,382 million/1 unit
    - 1993P—$2,464 million/1 unit
  - Plans
    - Ongoing production; nine planned by the end of the decade

Space Systems

Listed below are two of the more visible space programs:

- Defense Support Program (DSP) (U.S. Air Force)
  - Contractor(s)
    - TRW (prime)
  - Funding
    - 1991A—$674 million/1 unit
    - 1992P—$273 million/0 units
    - 1993P—$653 million/1 unit
  - Plans
    - Ongoing production with plans for nine of these early warning satellites
- Strategic Defense Initiative (Multiservice)
  - Contractor(s)
    - Lockheed and others
  - Funding
    - 1991A—$2,874 million/NM
    - 1992P—$4,581 million/NM
    - 1993P—$4,933 million/NM
  - Plans
    - Key emphasis on Global Protection Against Limited Strikes (GPALS)

Military Electronics OEMs

Table 6 lists the largest military electronics OEMs and their principal technology participation.

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Table 6
Principal Military/Aerospace Electronic Equipment Producers

Company	Radar		Sonar	Missile Weapon	Space	Navigation	Communications	Electronic Warfare
	Airborne	Ship/Ground						
GM Hughes Electronics	X	X	X	X	X		X	X
Thomson-CSF	X	X	X	X	X		X	X
GE	X	X		X	X		X	X
Raytheon		X	X	X			X	X
GEC Plessey	X	X	X	X	X	X	X	X
Lockheed		X	X	X	X			X
TRW					X	X	X	X
Unisys		X				X	X	
Martin Marietta	X			X	X	X		
Rockwell	X			X	X	X	X	X
Texas Instruments	X			X		X		X
Litton				X		X	X	X
Honeywell			X	X	X	X	X	X
Westinghouse	X	X	X	X	X		X	X
IBM	X		X		X			
ITT		X			X	X	X	X
Deutsche Aerospace		X	X	X	X	X		X
E-Systems					X	X	X	X
Northrop				X		X		X
General Dynamics				X	X		X	
Harris					X		X	
Loral/Ford	X			X	X		X	X
GTE							X	X
Ferranti	X	X			X	X		
Boeing	X			X	X			X
British Aerospace				X	X	X	X	X
Allied-Signal	X			X	X	X	X	
Philips				X	X	X	X	
Thorn-EMI	X	X		X				
Mitsubishi	X	X	X	X	X	X		
Motorola				X	X		X	X
AT&T			X		X		X	X
Siemens	X	X					X	X
Sextant Avionique						X	X	
Smiths Industries					X	X	X	
Dassault Electronique	X	X		X	X			X
AIL Systems	X	X					X	X
Toshiba				X	X			
Emerson Electric	X	X				X	X	X
NEC					X	X	X	
Ericsson	X	X			X		X	X
McDonnell Douglas				X	X		X	
IAI/Elta	X	X	X	X	X	X		X
Racal						X	X	X
Grumman	X			X	X			
Selenia	X	X	X	X	X	X		X
Tadiran/Elisra							X	X
Matra				X	X			

(Continued)

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Table 6 (Continued)
Principal Military/Aerospace Electronic Equipment Producers

Company	Electro-Optic	Aircraft Systems	Computer	Simulat. Trainers	Test	Other
GM Hughes Electronics	X	X	X	X	X	Semicond., microwave subsys.
Thomson-CSF	X	X	X	X	X	Semicond., microwave, CCD
GE	X	X	X	X	X	Semiconductors
Raytheon			X			Semiconductors
GEC Plessey	X	X	X	X	X	Semicond., microwave subsys.
Lockheed	X	X	X	X	X	Semicond., microwave subsys.
TRW	X	X	X	X		Semicond., microwave subsys.
Unisys		X	X	X		
Martin Marietta	X					
Rockwell	X	X	X		X	Semiconductors
Texas Instruments	X		X		X	Semicond., microwave subsys.
Litton	X		X			Microwave subsys.
Honeywell	X	X	X	X		Semiconductors
Westinghouse	X	X	X			Semiconductors
IBM		X	X	X		Semiconductors
ITT	X	X				Semicond., microwave subsys.
Deutsche Aerospace	X					
E-Systems				X		
Northrop	X	X			X	
General Dynamics		X		X	X	
Harris		X	X	X		Semicond., microwave subsys.
Loral/Ford	X	X	X	X	X	Semicond., microwave subsys.
GTE	X					
Ferranti	X	X				
Boeing	X	X		X	X	
British Aerospace	X	X	X	X	X	
Allied-Signal		X			X	Semiconductors
Philips						Semiconductors
Thorn-EMI	X		X	X		Semiconductors
Mitsubishi		X		X	X	Semiconductors
Motorola		X	X		X	Semiconductors
AT&T	X	X	X			Semicond., microwave subsys.
Siemens		X	X			Semiconductors
Sextant Avionique		X	X			
Smiths Industries	X	X	X			
Dassault Electronique	X		X			
AIL Systems			X			
Toshiba						Semiconductors
Emerson Electric	X	X	X		X	
NEC			X			Semiconductors
Ericsson	X	X	X	X	X	Semiconductors
McDonnell Douglas	X	X		X		
IAI/Elta	X	X		X	X	
Racal	X	X	X			
Grumman		X		X	X	
Selenia	X					
Tadiran/Elisra			X			
Matra	X					

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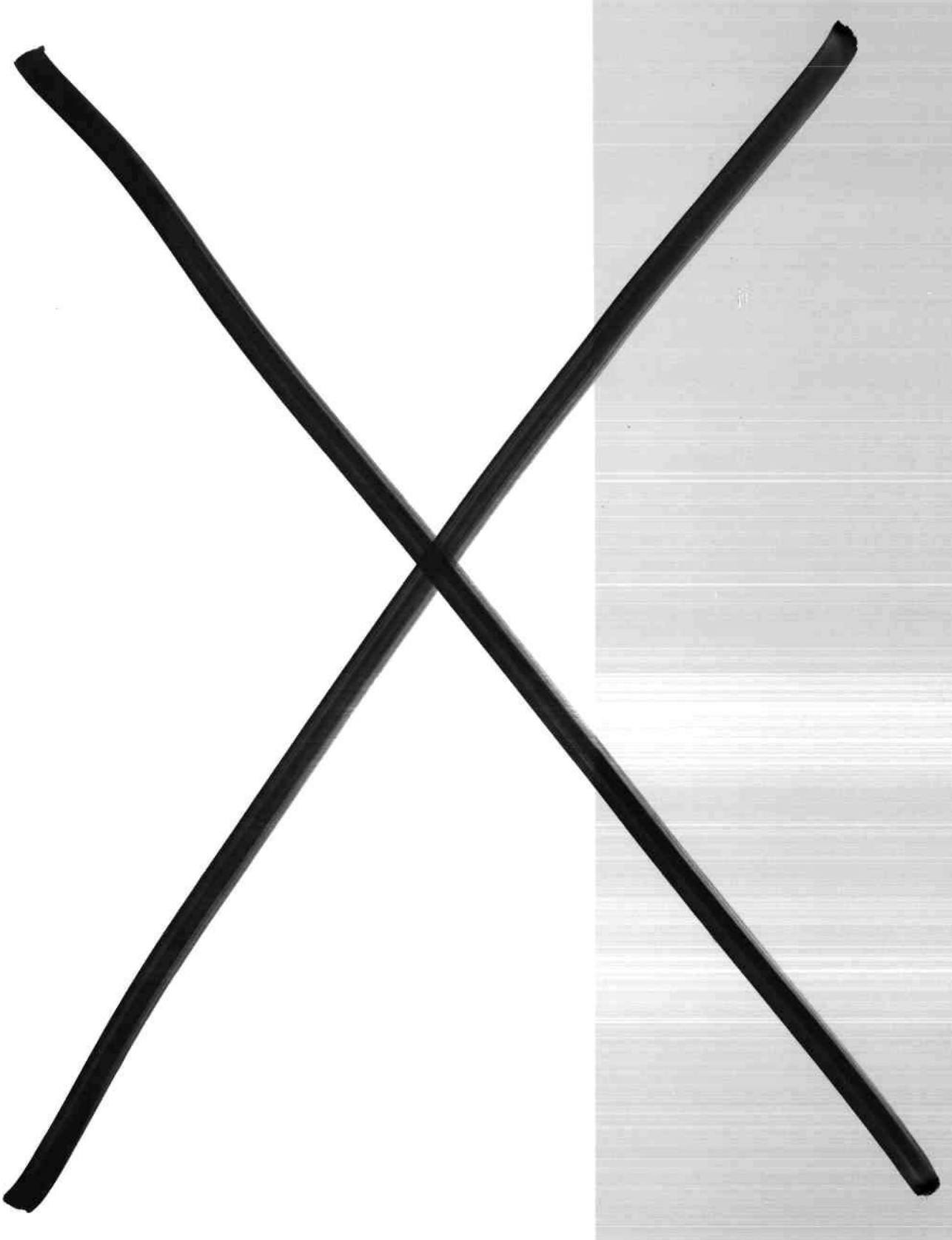
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0010337



Dataquest

Semiconductor Application Markets *Worldwide*

Company Backgrounders

Company	Fiscal Year-End
Acer Group, The	December
American Telephone & Telegraph Company (AT&T)	December
Apple Computer Inc.	September
Compaq Computer Corporation	December
Digital Equipment Corporation (DEC)	June
Everex Systems Inc.	NA
Fujitsu Ltd.	March
GM Hughes Electronics Corporation	December
Hewlett-Packard Company (HP)	October
Hitachi Ltd.	March
International Business Machines Corporation (IBM)	December
ITT Corporation	December
Lucky Goldstar Group	NA
Matsushita Electric Industrial Company Ltd.	March
Mitsubishi Electric Corporation	March
NCR Corporation	December
NEC Corporation	March
Northern Telecom Limited	December
Olivetti S.p.A Ing. C	December
Raytheon Company	December
Philips Gloeilampenfabrieken N.V.	December
Samsun Electronics Company Ltd.	December
Siemens AG	September
Silicon Graphics Inc.	June
Sony Corporation	March
Sun Microsystems Inc.	June
Tandy Corporation	June
Toshiba Corporation	March
Unisys Corporation	December
Western Digital Corporation	June
Xerox Corporation	December

NA = Not available

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SEMICONDUCTOR APPLICATION MARKETS

COMPANY BACKGROUNDERS

Company	Fiscal Year-End
American Telephone & Telegraph Company	December
Apple Computer, Inc.	September
Digital Equipment Corporation (DEC)	June
Eastman Kodak Company	December
General Electric Company	December
GM Hughes Electronics Corporation	December
Groupe Bull	December
Hewlett-Packard Company	October
International Business Machines Corporation (IBM)	December
ITT Corporation	December
Lockheed Corporation	December
Motorola, Incorporated	December
NCR Corporation	December
Northern Telecom Limited	December
Raytheon Company	December
Rockwell International Corporation	September
Tandy Corporation	June
TRW Incorporated	December
Unisys Corporation	December
Xerox Corporation	December

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American Telephone & Telegraph Company

550 Madison Avenue
New York, New York 10022
Telephone: (212) 605-5500
Fax: (212) 605-6248
Dun's Number: 00-698-0080

Date Founded: 1885

CORPORATE STRATEGIC DIRECTION

American Telephone & Telegraph Company (AT&T), incorporated in 1885, is a major participant in two industries. In the global information movement and management industry, AT&T provides quality products, systems, and services in the U.S. and international markets. The Worldwide Intelligent Network carries voice, data, image, and facsimile message around the world. In addition, AT&T telecommunications and computer products can be networked into integrated systems and provide global access to information. AT&T is also in the general-purpose credit card business and provides value-added financial and leasing services for AT&T and other equipment.

AT&T's mission is to apply the talents, knowledge, and skills of its employees to ensure the company's place as the global leader in enabling customers to reap the benefits of information technology.

In January 1984, AT&T divested itself of the exchange telecommunications, exchange access, and printed directory advertising portions of the 22 Bell Operating Companies (BOCs), as well as the cellular advanced mobile communications service business. The former Bell System territory in the continental United States was divided into 161 geographic areas, which have been termed local access and transport areas (LATA).

AT&T provides interstate and intrastate interLATA long distance telecommunications services throughout the United States and provides interconnection with telecommunications systems worldwide. In the continental United States, AT&T provides long distance services over its own networks using lightwave, satellite, wire and coaxial cable, and microwave radio technology. International telecommunications services are provided via undersea cable and satellite transmission facilities. AT&T is subject to the jurisdiction of the Federal Communications Commission (FCC) with respect to interstate and international rates, lines and services, and other matters. In March 1989, the FCC adopted a system of regulating AT&T known as price caps, under which AT&T's prices rather than its earnings level will be limited.

Total revenue increased by 3 percent to $37.3 billion* in fiscal 1990 from $36 billion in fiscal 1989. Net income was $2.74 billion in fiscal 1990, up from $2.7 billion in fiscal 1989. AT&T employs 274,000 people worldwide.

AT&T's revenue comes from sales of telecommunications services, products and systems, and rental and other income. In 1990, sales from telecommunications services represented 53 percent of the company's revenue; sales from products and systems represented 33 percent; and rental and other revenue represented 14 percent of total revenue.

Research and development expenditure totaled $2.4 billion in fiscal 1990, representing 6.5 percent of revenue. Capital spending expenditure totaled $3.6 billion in fiscal 1990, representing about 9.7 percent of revenue.

AT&T operates manufacturing facilities domestically and internationally in locations including Mexico, Singapore, Spain, and Thailand. AT&T also operates many design centers worldwide, including locations in England, France, Italy, Singapore, Spain, and Germany. In addition, AT&T operates all the Phone Center stores in the United States.

*All dollar amounts are in U.S. dollars.

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More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 5, at the end of this backgrounder, present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

AT&T's business units and supporting divisions are clustered into the following functional groups: the Communications Services Group, the Communications Products Group, the Data Systems Group, the Network Systems Group, the Federal Systems Group, and the International Group.

The Communications Services Group

The Communications Services Group addresses the needs of large and small businesses, the federal government, state and local governments, and consumers for voice, data, and image telecommunications services. Business units within this group provide regular and custom long distance communications services, including message telecommunications service (MTS), wide-area telecommunications service (WATS), toll-free or 800 service, 900 services, private-line services, and Integrated Services Digital Network (ISDN) technology-based services. They also provide special long distance services including AT&T Calling Card services, special calling plans, and domestic and international operators.

During 1990, AT&T purchased Western Union's business services group. That unit joined existing AT&T operations to become AT&T EasyLink Services. The new business unit is made up of Western Union's e-mail and telex businesses and AT&T's e-mail, electronic data interchanges, and enhanced facsimile services.

The Communications Products Group

The Communications Products Group addresses the equipment needs of large and small businesses, the federal government, state and local governments, and consumers. Business units in this group offer products such as private branch exchanges including the Definity 75/85 system and the System 25, other business communications systems, corded and cordless residence telephones, public telephones, answering systems, typewriters and word processors, security systems, facsimile machines, modems, and the Merlin and Spirit communications systems.

The Data Systems Group

The Data Systems Group includes business units that provide computer and data networking products and systems and the UNIX Operating System and related software. The group particularly addresses the market for data networking—systems for connecting a few computers or many computer networks. Products include mini- and personal computers, data terminals, LAN products, printers, and UNIX System V software.

The Network Systems Group

The Network Systems Group includes business units that primarily manufacture, market, engineer, and install switching systems, transmission systems, cable and wire products, cellular systems, and operations systems for AT&T, local exchange carriers, other carriers, private businesses, government agencies, overseas telephone administrations, and others. Switching systems include the 5ESS switch. Transmission systems include lightwave and digital radio products, digital cross-connect and multiplex products, and digital loop carrier products. Cable and wire products include fiber optics, copper and fiber-optic cable, and related apparatus. Operations systems include mechanized systems for managing telecommunications networks.

The Network Systems Group also includes AT&T Microelectronics, a business unit that produces two broad categories of components: integrated circuits (ICs) and other electronics components such as discrete components, power systems, and printed wiring boards, which are included in most AT&T products and systems. Some of these components are sold commercially to other companies.

The Federal Systems Group

The Federal Systems Group markets and maintains special design products and systems; related special services; and other AT&T products, systems, and services to and for the federal government.

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The International Group

The International Group supports AT&T business units in providing products and systems to international customers, provides AT&T's communications services internationally, and sells submarine cable systems.

The company's operations in the financial services and leasing industry are conducted through AT&T Capital Corporation and AT&T Universal Card Services Corporation, wholly owned subsidiaries of AT&T.

AT&T Capital Corporation

AT&T Capital operates its business through six strategic business units. AT&T Credit primarily provides financing for AT&T customers acquiring AT&T and associated equipment. AT&T Capital Holdings International Inc. provides lease and project financing, automotive leasing, and international financing services. AT&T Commercial Finance Corporation provides inventory financing for equipment dealers and distributors, specialized financing products and services for broadcast media and franchise owners and operators, as well as middle-market general equipment leasing. AT&T Systems Leasing Corporation provides leasing products and asset management remarketing services for mainframes and other data-related products. Eaton Financial Corporation provides small-ticket leasing programs for manufacturers and distributors as well as direct leasing of business equipment to end users. AT&T Capital Services, through United States Instrument Rentals Inc., rents electronic, chemical, and analytical test equipment primarily through short-term rental agreements.

AT&T Universal Card Services

The AT&T Universal Card is a general-purpose consumer credit and calling card service. The features of the card include no annual fee for charter members that make at least one purchase a year and a 10 percent discount on AT&T's calling card rates.

Further Information

For further information about the company's business segments, please contact the Dataquest Telecommunications service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	34,213	33,768	35,218	36,149	37,285
Percent Change	-	(1.30)	4.29	2.64	3.14
Capital Expenditure	3,587	3,482	3,917	3,548	3,603
Percent of Revenue	10.48	10.31	11.12	9.81	9.66
R&D Expenditure	2,278	2,453	2,572	2,652	2,433
Percent of Revenue	6.66	7.26	7.30	7.34	6.53
Number of Employees	316,900	303,000	304,200	283,500	273,700
Revenue ($K)/Employee	107.96	111.44	111.44	111.44	111.44
Net Income	139	2,044	(1,669)	2,697	2,735
Percent Change	-	1,370.50	(181.65)	261.59	1.41

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	8,904.00	9,038.00	9,379.00	9,964.00
Quarterly Profit	668.00	657.00	712.00	698.00

Source: AT&T Company
Annual Reports and Forms 10-K
Dataquest (October 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1988	1989	1990
North America	100.0	100.0	100.0
International	0	0	0

Source: AT&T Company
Annual Reports and Forms 10-K
Dataquest (October 1991)

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1991 SALES OFFICE LOCATIONS

United States—3,000
International—More than 100

MANUFACTURING LOCATIONS

North America

Allentown, Pennsylvania
ICs, microprocessors, communications devices, thin-film devices
Burlington, North Carolina
Military electronic systems, metal fabrication, power equipment, commercial electronic systems
Clark, New Jersey
Undersea cable repeaters associated with undersea telephone cable networks
Columbus, Ohio
Electronic switching systems
Denver, Colorado
Digital PBX products, Merlin controllers
Kansas City, Missouri
ICs, transistors, diodes, relays, surge protectors, switches, varistors, thermistors
Largo, Florida (AT&T Paradyne)
Modems, multiplexers, and channel extenders
Little Rock, Arkansas
Display terminals, data terminals, STARLAN local area network products, controllers, communications system
Mesquite, Texas
Power supply, interconnect products, off-line switches
Montgomery, Illinois
Data modems, data communications equipment, printed wire boards
Norcross, Georgia
PIC exchanges, lightguide cable, CONNECS
North Andover, Massachusetts
Lightwave transmission systems, digital carrier terminal systems
Omaha, Nebraska
Network distribution apparatus, electronic cable and wire, metal fabrication
Orlando, Florida
ICs
Phoenix, Arizona
Exchange cable, custom and connector cable, switchboard and inside wire
Reading, Pennsylvania
ICs, lightwave devices, optoelectronic devices, microwave devices, magnetic bubbles
Richmond, Virginia
Multilayer printed wiring boards
Shreveport, Louisiana
Electronic business sets, public phones, Merlin and Spirit systems
Staten Island, New York
Cable

Europe

Broendby, Denmark
Optical fibers
Hilversum, Netherlands
Digital switching system, transmission equipment
Tres Cantos, Spain
Chips manufacturing
Wicklow, Ireland
Transmission equipment, digital microwave systems

ROW

Bangkok, Thailand
Semiconductor assembly and testing
Matomoros, Mexico
Transformers, inductors, other components
Seoul, Korea (2)
Fiber-optic cable, switching equipment, lightwave systems, telephones
Singapore (2)
Semiconductor assembly and testing, and cordless telephones
Taipei, Taiwan
Switch and transmission equipment

SUBSIDIARIES

North America

Actuarial Sciences Associates Inc. (United States)
American Transtech Inc. (United States)
AT&T Communications Inc. (United States)
AT&T Communications of California Inc. (United States)
AT&T Communications of Delaware Inc. (United States)
AT&T Communications of Illinois Inc. (United States)

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AT&T Communications of Indiana Inc. (United States)
AT&T Communications of Maryland Inc. (United States)
AT&T Communications of Michigan Inc. (United States)
AT&T Communications of the Midwest Inc. (United States)
AT&T Communications of the Mountain States Inc. (United States)
AT&T Communications of Nevada Inc. (United States)
AT&T Communications of New England Inc. (United States)
AT&T Communications of New Hampshire Inc. (United States)
AT&T Communications of New Jersey Inc. (United States)
AT&T Communications of New York Inc. (United States)
AT&T Communications of Ohio Inc. (United States)
AT&T Communications of the Pacific Northwest Inc. (United States)
AT&T Communications of Pennsylvania Inc. (United States)
AT&T Communications of the South Central States Inc. (United States)
AT&T Communications of the Southern States Inc. (United States)
AT&T Communications of the Southwest Inc. (United States)
AT&T Communications of Virginia Inc. (United States)
AT&T Communications of Washington, D.C. Inc. (United States)
AT&T Communications of West Virginia Inc. (United States)
AT&T Communications of Wisconsin Inc. (United States)
AT&T Credit Corporation (United States)
AT&T Information Systems Inc. (United States)
AT&T Nassau Metals Corporation
AT&T Network Systems International (United States)
AT&T of Puerto Rico Inc. (Puerto Rico)
AT&T of the Virgin Islands Inc. (Virgin Islands)
AT&T Paradyne Corporation (United States)
AT&T Resource Management Corporation (United States)
AT&T Ricoh Company Ltd. (United States)
AT&T Technologies Inc. (United States)
Bell Telephone Laboratories Inc. (United States)

Europe

AT&T International Inc. (Spain)
AT&T Microelectronica de Espana S.A. (Spain)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

Olin Hunt Specialty Products

AT&T Bell Laboratories will license the secrets of a new ultraviolet photoresist to Olin Corporation's Olin Hunt Specialty Products. This process claims to enable chips to be fabricated to design rules as fine as 0.3 micron without resorting to X-ray lithography. The Olin unit will produce and market the chemical under license; it is expected to be available for use within 18 months.

1989

Hampshire Instruments Inc.

AT&T Bell Laboratories and Hampshire Instruments Inc. agreed to work jointly in three areas of X-ray lithography development. The agreement includes work in X-ray optics, reticle technology, and X-ray resists. To support the joint-development work, Hampshire Instruments has built a Class 100 clean room equipped with a Hampshire Series 5000 X-Ray Stepper, metrology capability, and a reticle pilot line.

ICI Advanced Materials

AT&T Bell Laboratories and ICI Advanced Materials jointly developed a family of radio frequency and microwave resonators constructed with high-temperature superconductors.

GTE

AT&T and GTE Corporation entered into a joint venture to develop new technology and capabilities for GTE's digital switching systems. The new company is known as AG Communications Systems Corporation. Under the agreement, AT&T has a 49 percent interest in the joint venture, acquired at a cost of approximately $112 million, and will increase its ownership to 80 percent in 5 years and to 100 percent in 15 years.

Pyramid Technology Corporation

AT&T and Pyramid Technology Corporation entered into a strategic partnership to jointly develop a new generation of high-performance UNIX-based systems. The agreement also includes provisions for AT&T to market the systems on an OEM basis.

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Paradigm Technology
AT&T Microelectronics and Paradigm Technology will codevelop high-speed random-access memory chips.

Digital Equipment Corporation
AT&T and Digital Equipment Corporation will develop an application interface between PBX and VAX platforms that will bring integrated voice and data applications to desktops.

Intel
AT&T and Intel Corporation entered into an agreement to collaborate on marketing LAN and ISDN circuits.

1988

Sun Microsystems Inc.
AT&T and Sun Microsystems Inc. entered into a strategic alliance whereby the companies will work together to develop a new computer platform that will use a unified version of AT&T's UNIX System V computer operating system and Sun's Scaleable Processor Architecture (SPARC). This will allow customers to protect software investments and take advantage of new technology.

Zenith
AT&T and Zenith entered into an agreement under which both companies will codevelop high-definition television (HDTV) systems.

Telefonica
AT&T and Telefonica, Spain's national telephone company, entered into a joint venture. The new company, known as AT&T Microelectronica de Espana S.A., will produce ICs.

MERGERS AND ACQUISITIONS

1991

NCR Corporation
AT&T and NCR Corporation announced a joint-merger agreement in May 1991 for the acquisition of NCR by AT&T in an all-stock transaction valued at approximately $7.4 billion. Under the agreement, which was amended in July 1991 and is subject to approval by NCR stockholders, each NCR share would be exchanged for $0.74 worth of AT&T shares. AT&T believes that the company that will emerge will be equipped to meet customers needs in the future—global computer networks as easy to use and as accessible as the telephone network is today.

1990

Eaton Financial Corporation
AT&T acquired Eaton Financial Corporation, an office equipment financing company, in exchange for approximately 2 million shares of AT&T common stock.

Sun Microsystems Inc.
AT&T acquired an interest in Sun Microsystems Inc. a computer company. During 1989, AT&T raised its ownership in Sun to 16.4 percent. However, in 1991 it sold all its interest, except for 3 million shares.

ISTEL Group Ltd.
AT&T acquired ISTEL Group Ltd., an information technology services company based in the United Kingdom, for approximately $285.

Western Union
AT&T and Western Union merged and joined an existing AT&T operation entitled AT&T EasyLink Services.

1989

Italtel S.p.A.
AT&T acquired a 20 percent share in Italtel S.p.A. in exchange for a 20 percent interest in AT&T Network Systems International B.V. (AT&T NSI), plus $135 million in cash. Italtel is a manufacturer of public and private telecommunications systems based in Italy.

Paradyne Corporation
AT&T acquired Paradyne Corporation, a leading modem manufacturer, for $250 million.

CIR
AT&T swapped its 22 percent stake in Ing. C. Olivetti & C. S.p.A.'s voting stock for an 18.6 percent share in CIR, a diversified holding company.

1988

AT&T NSI
AT&T acquired a majority interest in Network Systems International (NSI), AT&T's joint venture with N.V. Philips, by increasing its ownership to 60 percent.

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Compania Telefonica Nacional de Espana
AT&T owns 80 percent of AT&T Microelectronica de Espana S.A., a joint venture to produce integrated circuits with Compania Telefonica Nacional de Espana.

Ricoh of Japan
AT&T owns 51 percent of AT&T Ricoh Company Ltd., a joint venture with Ricoh of Japan to manufacture a Japanese version of AT&T's Merlin II system.

Taiwanese Government
AT&T owns 70 percent of AT&T Taiwan Telecommunications Co. Ltd., a joint venture with the Taiwanese government to manufacture switching systems.

GoldStar Group of Republic of Korea
AT&T owns 44 percent of a joint venture with the GoldStar Group to manufacture and market switching products and distribute AT&T 3B computers in Korea. AT&T also owns 50 percent of a joint venture with GoldStar to manufacture fiber-optic cable for the Korean market.

Nordic Kable and Wire Works (NKT)
AT&T owns 51 percent of Lycom, a joint venture with Nordic Kable and Wire Works to manufacture optical fiber in Denmark.

Japanese ENS Corporation
AT&T owns 50 percent of Japan ENS Corporation, a joint venture with 22 Japanese companies to provide value-added network services in Japan.

KEY OFFICERS

Robert E. Allen
Chairman and chief executive officer

W. Frank Blount
Group executive, Communications Products

Richard S. Bodman
Senior vice president, Corporate Strategy and Development

Harold W. Burlingame
Senior vice president, Human Resources

Robert M. Kavner
Group executive, Data Systems, Federal Systems, and Communication Products

Marilyn Laurie
Senior vice president, Public Relations and Employee Information

William B. Marx
Group executive, Network Systems

Victor A. Pelson
Group executive, Communications Services

John Mayo
President, AT&T Bell Laboratories

Alex Mandel
Vice chairman and chief financial officer

Randall L. Tobias
Vice chairman

Sam R. Willcoxon
Group executive, International

John D. Zeglis
Senior vice president, general council and government affairs

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Information is not available.

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Table 3
Balance Sheet
Fiscal Year Ending in December
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash	2,602	2,787	2,021	1,183	1,389
Receivables	7,820	8,038	8,907	9,555	12,290
Marketable Securities	0	0	0	0	0
Inventory	3,519	3,157	3,392	3,206	2,626
Other Current Assets	1,631	1,340	1,282	1,347	1,471
Total Current Assets	15,572	15,322	15,602	15,291	17,776
Net Property, Plants	21,078	20,808	15,280	15,919	17,472
Other Assets	2,233	3,343	4,270	6,477	8,527
Total Assets	38,883	39,473	35,152	37,687	43,775
Total Current Liabilities	11,217	10,889	11,225	12,237	15,089
Long-Term Debt	7,309	7,917	8,128	8,144	9,118
Other Liabilities	6,807	6,212	4,334	4,568	5,475
Total Liabilities	25,333	25,018	23,687	24,949	29,682
Converted Preferred Stock	0	0	0	0	0
Common Stock	1,072	1,074	1,074	1,076	1,092
Other Equity	8,544	8,605	8,613	8,700	8,835
Retained Earnings	3,934	4,776	1,778	2,962	4,166
Total Shareholders' Equity	13,550	14,455	11,465	12,738	14,093
Total Liabilities and Shareholders' Equity	38,883	39,473	35,152	37,687	43,775

Source: AT&T Company
Annual Reports and Forms 10-K
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Table 4
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	34,213	33,768	35,218	36,149	37,285
Cost of Sales	18,312	16,651	23,575	16,562	16,891
R&D Expense	2,278	2,453	2,572	2,652	2,433
SG&A Expense	11,101	11,148	12,130	12,634	13,136
Capital Expense	3,587	3,482	3,917	3,548	3,603
Pretax Income	133	3,185	(3,382)	3,992	4,229
Pretax Margin (%)	0.39	9.43	(9.60)	11.04	11.34
Effective Tax Rate (%)	NA	35.80	34.00	34.00	34.00
Net Income	139	2,044	(1,669)	2,697	2,735
Shares Outstanding, Millions	1,071	1,073	1,075	1,077	1,089
Per Share Data					
Earnings	0.05	1.88	(1.55)	2.50	2.51
Dividend	1.20	1.20	1.20	1.20	1.20
Book Value	12.65	13.47	10.67	11.83	12.94

NA = Not available

Source: AT&T Company
Annual Reports and Forms 10-K
Dataquest (October 1991)

Table 5
Key Financial Ratios
Fiscal Year Ending in December

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	1.39	1.41	1.39	1.25	1.18
Total Assets/Equity (%)	286.96	273.08	306.60	295.86	310.62
Current Liabilities/Equity (%)	82.78	75.33	97.91	96.07	107.07
Total Liabilities/Equity (%)	186.96	173.08	206.60	195.86	210.62
Profitability (%)					
Return on Assets	0.36	5.18	(4.75)	7.16	6.25
Return on Equity	1.03	14.14	(14.56)	21.17	19.41
Profit Margin	0.41	6.05	(4.74)	7.46	7.34
Other Key Ratios					
R&D Spending % of Revenue	6.66	7.26	7.30	7.34	6.53
Capital Spending % of Revenue	10.48	10.31	11.12	9.81	9.66
Employees	316,900	303,000	304,200	283,500	273,700
Revenue ($K)/Employee	107.96	111.45	115.77	127.51	136.23
Capital Spending % of Assets	9.23	8.82	11.14	9.41	8.23

Source: AT&T Company
Annual Reports and Forms 10-K
Dataquest (October 1991)

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Canon Incorporated

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Shinjuku-ku, Tokyo 163, Japan
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Fax: (81-3) 3349-8519
Dun's Number: 69-054-9662

Date Founded: 1937

CORPORATE STRATEGIC DIRECTION

Canon Incorporated, a Japanese parent/holding company, is the world's largest (in unit sales) maker of copiers and a leading producer of office equipment and cameras. Its business is divided into three product segments, namely, Business Machines, Cameras, and Optical Products. The company conducts the majority of its business in Japan, Europe, and North America with approximately 30 percent of net sales coming from each respective region.

Fiscal year 1990 marked the midpoint of Canon's global corporation plan, a five-year plan designed to address the three main market factors affecting the company: trade sanctions, exchange rate risk, and a rapidly expanding global economy. According to the company, acceleration of the plan strategy in 1990 resulted in another record year for profits and sales. The plan calls for an increase in international investment and production. This increase limits the effects of trade sanctions because products manufactured outside Japan are not considered Japanese, but native to the country in which they are manufactured. Also, by increasing foreign investment and production, Canon's foreign branches are becoming more self-sufficient, thereby decreasing the number of cross-border transactions and reducing the company's exposure to interest-rate volatility. In addition, by establishing a direct interest in the foreign market, the company gains a closeness to the market that it would not otherwise be able to achieve.

The company announced, during 1991, that it will pursue the following four major activities in order to reach its long-term goals for the twenty-first century:

- The strengthening of each member company, resulting in a stronger Canon group. Activities conducted to reach this goal will include adding to headquarters operations and refining the company's internal global information network, called GINGA.
- The renovation of its corporate structure on a global scale. For example, in Asia production facilities will be expanded, and Canon hopes that this will meet the Asian people's expectations of job creation in each country. The global structure of the company will also be changed.
- The improvement of business activities in all areas. First, Canon will reorganize and reinforce its R&D program to improve fundamental research, materials development, and software capabilities. At the same time, the company plans to reorganize its Business Machines operations. Second, Canon will promote a new "EQCD" approach by adding "E" (for ecology and environment) to the head of its previously stated quality, cost, and delivery guidelines for development and production systems. In addition, sales capability will be reinforced in order to meet future market challenges.
- The acceptance of greater social responsibility. At present, the focus of this is on the environment. A company-wide policy for environmental protection has already been put into effect, and during 1991 steady progress is expected to be made in putting ecologically sound practices into action.

The company's net revenue increased by 27.9 percent to ¥1,727 billion (US$11.92 billion) in fiscal 1990 from ¥1,351 billion (US$9.79 billion) in fiscal 1989. (Percentage changes refer only to ¥ amounts; US$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Sales in each of Canon's business segments were up by at least 23 percent in 1990. Canon employed 54,381 people worldwide at the end of 1990.

Net income in 1990 increased by 60.4 percent from the previous year to ¥61.4 billion (US$423.5 million), or a 3.6 percent return on sales. This increase was

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primarily attributable to the increase in revenue previously mentioned and a higher gross profit ratio, which improved by 1.2 percent from the previous year to 44.2 percent. R&D expense increased 5.0 percent to ¥86.0 billion (US$593 million) in fiscal 1990 from ¥75.6 billion (US$548 million) in fiscal 1989. However, as a percentage of revenue, R&D expense declined slightly to 5.0 percent.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 7, at the end of this backgrounder, present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Business Machines

Canon's Business Machines segment is made up of three groups—copiers, computer peripherals, and business systems. In 1990, these three groups had combined total sales of ¥1,362 billion (US$9.4 billion), representing approximately 79 percent of the company's total revenue.

Copiers

The copiers group of Canon's Business Machines segment accounted for 40 percent of the company's total revenue in 1990. In the rapidly expanding full-color copier market, Canon maintained its leading ranking with two of its best-selling models, the Color Laser Copier 500 (CLC-500) and the CLC-200, which continued to hold their position among the leaders in this competitive market. Future plans call for these digital color laser copiers to form the output stage of color facsimile transmissions. Canon is also marketing the BJ-A1 copier, which makes use of the company's bubble jet technology to print an A1-size sheet in six minutes.

The NP series is Canon's most popular range of office copiers, and orders for these machines continue to grow at a steady pace. The NP series leads all other Canon products in global production; Canon has facilities for the series in the United States, France, and Germany, and will soon have a new site in Thailand. The NP lineup was given a major boost in 1990 with the introduction of the NP9800, a high-end copier offering improved image quality through the use of fuzzy logic—a technology that ensures high reliability, uniform images, and smoother paper feed. The NP9800 also offers a copying speed of 85 A4 sheets per minute with adoption of the highly durable amorphous-silicon photosensitive drum. Another high-end model, the NP6560, sold well in 1990, and among the low-end and midrange models sales of the NP1515—the only A3 copier in the world to use a cartridge—and the NP2020 were particularly good. In early 1991, Canon introduced its NP3825II, a 26 copies per minute (cpm) copier designed for growing businesses. The NP3825II features standard automatic duplexing for easier document handling and higher productivity and an optional reversing automatic document feeder that processes up to 30 one- and two-sided originals. Other key features include a wide-range zoom to reduce or enlarge any image from 50 percent to 200 percent in 1 percent increments and four preset reduction ratios.

As the originator of the personal copier market, Canon has maintained its position as a market leader in this field. The company's success here has been largely due to its nearly maintenance-free cartridge, which incorporates the photosensitive drum, developing unit, charger, cleaner, and toner in a single unit. The latest Canon technical breakthrough eliminates the usual warm-up time by replacing the conventional thermal fixing rollers with the new surface rapid fusing (SURF) system, an efficient technology that consumes less power than other systems do. The SURF system is now incorporated in the recently announced Canon PC-1 and PC-2 low-end personal copiers, which both contributed significantly to company revenue.

Computer Peripherals

The computer peripherals segment of Canon's product line includes laser beam printers (LBPs) and bubble jet (BJ) printers. Sales from this segment increased 26.8 percent to ¥347.5 billion (US$2.40 billion) in fiscal 1990.

Canon's product line in the LBP market consists of the LBP-8 MARK III printer series and the LBP-4 printer. The three products in the LBP-8 MARK III series each come equipped with scalable fonts, 1.5MB standard memory, 8-ppm printing speed, increased software support, and improved vector graphics capabilities. However, the LBP-8 MARK III T printer also offers dual paper cassettes not found in the LBP-8 MARK III, while the LBP-8 MARK III R

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offers the same features as the MARK III T plus double-sided printing for more versatility and convenience. The LBP-4 was Canon's first 4-ppm desktop laser beam printer and offers a printing resolution of 300 dpi with nine built-in scalable fonts. All of Canon's laser beam printers utilize the company's printing system language controller, which supports scalable fonts to enlarge, reduce, and fill type.

The company's bubble jet technology utilizes a print head that contains 14 nozzles per millimeter, each with a heating element that, when activated, raises the temperature of the ink, causing a bubble to form near the nozzle. The rapid expansion of the bubble forces a droplet of ink from the nozzle at high speed onto the paper. During 1990, Canon introduced the BJ-10E, a lightweight, low-cost, four-pound bubble jet printer that can be used as a portable or desktop device. The BJ-10E prints text at a speed of 83 to 142 cps, depending on the number of characters per inch, and accepts letter- or legal-size paper, envelopes, and a variety of transparencies. In late 1990, the company announced the BJ-300 and BJ-330 bubble jet printers, which are targeted at the business market and offer a print resolution of 360 dpi. The new printers come with emulators for IBM and Epson dot matrix printers and can also handle Courier, Prestige, and Gothic typefaces. When operating, they make only 45 decibels of noise, less than most dot matrix printer models. Both printers also come with a number of options, including a 128KB memory expansion card and a two-bin automatic sheet feeder that takes envelopes.

In data storage systems, Canon offers the optical memory card, which improves upon magnetic and integrated circuit designs by allowing users to store graphics as well as alphanumeric data. The card's technology embeds optical-recording material onto a 2MB plastic card, immunizing it from static electricity or magnetic forces and making it more difficult to alter. This new card has a higher storage capacity and costs less to manufacture than its predecessors. Applications for the card include personal identification, personal medical record storage, and security access cards.

Among other peripherals, Canon offers a new Information Display System, which is based on the company's expertise with electrophotography. The Information Display System is used for presenting information at, for example, public venues from train stations to exhibition halls. Information can be sent to many A1-sized displays simultaneously, and if A4-size written documents are run through a scanner they can be displayed in large form. Text can be displayed directly from a computer. One advantage of the Information Display System is that it can be used in well-lit areas, unlike overhead projectors, which demand a darkened room.

Business Systems

The business systems segment of Canon encompasses a broad range of products, including facsimile transceivers, computers, electronic typewriters, Japanese-language word processors, micrographics equipment, and calculators. The segment reported a 20.3 percent increase in total revenue in 1990, based on sales of ¥328.6 billion ($US2.27 billion).

Facsimile transceivers make up the largest part of Canon's business systems segment. Recent products announced by the company in this area include the FAXPHONE 26, the FAX-L4600, and the FAX-270S. The FAXPHONE 26 features automatic dialing to 65 locations, a 15-page automatic document feeder, and high-speed transmission. Capable of transmitting as fast as 12 seconds per page, the FAXPHONE 26 can also be hooked up to a computer.

In mid-1990, Canon unveiled the FAX-L4600 digital laser facsimile, the first Group 4 (G4) model to incorporate the company's new ultrahigh-quality digital image processing technology for enhanced image quality. The L4600, designed for high-volume communication, also provides true networking capabilities by accepting documents from either a G3 or G4 terminal without reprogramming. Canon's FAX-270S is targeted at small businesses and can send up to 20 pages of data stored in memory automatically. Key features of the FAX-270S include a 328-foot paper roll, a 30-page automatic document feeder, and the capability to transmit documents at a speed of approximately 12 seconds per page.

Canon's new line of personal computers and the unique Navigator HD40, a virtually complete desktop office, give users the capability to handle the growing demands of any business.

In mid-1991, the company released three 20-MHz 80386-based PCs aimed at the home office marketplace, the C200 M50/HD40 (with a 40MB hard drive and 1MB RAM), the M50/HD80 (with a 80MB hard

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drive and 2MB RAM), and the M50/HD120 (with a 120MB hard drive and 2MB RAM). The machines are bundled with MS-DOS 4.01, Microsoft Works, Windows, and a starter kit for the Prodigy on-line service. Canon is offering each of these three machines in four configurations: standard, which includes the computer, keyboard, software, and PS/2 mouse; standard with the addition of a VGA monitor; standard with the addition of a Canon bubble jet printer and paper feeder; and maximum, with both a VGA monitor and a bubble jet printer.

Canon's Navigator HD40, its most innovative new product, is billed as an all-in-one office workstation. This compact, integrated personal workstation is built around a 10-MHz Intel 8086 microprocessor and includes a 40MB hard drive, a 3.5-inch floppy drive, a 10-inch EGA monitor, 640KB of RAM, and an external plain paper printer, facsimile machine, telephone, and answering machine.

Cameras

The camera is what first introduced the Canon name to the world. Along with cameras, Canon is involved in video camcorders, still video, and camera lenses. In 1990, the camera division accounted for 14.5 percent of total net sales, with both 35mm cameras and 8mm video camcorders selling exceptionally well.

Optical Products

The Optical Products segment comprises high-tech, precision products including semiconductor production equipment, broadcasting lenses, and medical equipment. The company is currently one of the largest suppliers of optical lithography equipment used in semiconductor device manufacturing. All product sectors in this segment recorded increases in 1990, and medical equipment such as the Laser Multiformer Imager had an especially good year of sales. As a whole, optical products contributed 6.7 percent to net sales.

Further Information

For further information about the company's business segments, please contact Dataquest's Electronic Printers service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	5,293.0	6,782.7	8,640.7	9,789.3	11,916.9
Percent Change	-	28.15	27.39	13.29	21.73
Capital Expenditure	483.8	441.0	649.0	777.5	946.9
Percent of Revenue	9.14	6.50	7.51	7.94	7.95
R&D Expenditure	329.3	396.4	511.9	547.6	593.2
Percent of Revenue	6.22	5.84	5.92	5.59	4.98
Number of Employees	35,498	37,521	40,740	44,401	54,381
Revenue ($K)/Employee	149.11	180.77	212.09	220.47	219.14
Net Income	63.9	91.8	289.8	277.5	423.5
Percent Change	-	43.81	215.62	(4.26)	52.62
Exchange Rate (US$1=¥)	168	144	128	138	145

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

Source: Canon Incorporated
Annual Reports
Dataquest (October 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
Japan	30.83	29.73	31.51	30.64	29.44
North America	34.77	32.48	30.24	30.55	29.85
Europe	27.45	30.48	30.70	31.36	33.37
ROW	6.95	7.31	7.55	7.45	7.34

Source: Canon Incorporated
Annual Reports
Dataquest (October 1991)

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1990 SALES OFFICE LOCATIONS

North America—8
Europe—20
Japan—4
ROW—11

MANUFACTURING LOCATIONS

North America

Canon Business Machines Inc. (United States)
Electronic typewriters, chemicals
Canon Virginia Inc. (United States)
Copiers, laser printers, and chemicals
C.S. Polymer Inc. (United States)
Chemical materials
SouthTech Inc. (United States)
Molded parts, pressed parts, and units parts

Europe

Canon Bretagne S.A. (France)
Copiers, chemicals, laser printers, facsimiles, and electronic typewriters
Canon Giessen GmbH (Germany)
Copiers, chemicals
Canon Manufacturing U.K. Ltd.
Lense units
Olivetti-Canon Industriale S.p.A. (Italy)
Copiers

Japan

Canon Aptex Inc. (Japan)
Copiers, copier units, and copier accessories
Canon Chemical Co. Inc. (Japan)
Copier rollers, rubber parts
Canon Components Inc. (Japan)
Printed circuits, hybrid ICs, and high-tech components
Canon Electronics Inc. (Japan)
Camera units, laser printers, micrographics, magnetic heads, floppy disk drives
Canon Precision Inc. (Japan)
Precision molded parts, micromotors
Canon Seiko Co. Inc. (Japan)
Chemicals, plastic molded parts
Copyer Co. Ltd. (Japan)
Copiers, chemicals
Nagahama Canon Inc. (Japan)
Laser printers, chemicals
Oita Canon Inc. (Japan)
Cameras
Optron Inc. (Japan)
Optical crystals, vapor deposition materials

ROW

Canon Business Machines de Mexico S.A. de C.V. (Mexico)
Printed circuits
Canon Camera (Malaysia) Sdn. Bhd. (Malaysia)
Compact cameras
Canon Dalian Business Machines Inc. (China)
Chemicals
Canon Hi-Tech (Thailand) Ltd. (Thailand)
Business machines
Canon Inc. (Taiwan)
Compact cameras, micrometers
Canon Opto (Malaysia) Sdn. Bhd. (Malaysia)
Video camera lenses, optical lenses
Canon Zhuhai Inc. (China)
Compact cameras
Lotte Canon Co. Ltd (Korea)
Copiers, facsimiles, and chemicals

SUBSIDIARIES

North America

Ambassador Office Equipment Inc. (United States)
Astro Office Products Inc. (United States)
Canon Business Machines Inc. (United States)
Canon Canada Inc. (Canada)
Canon Financial Services Inc. (United States)
Canon Information Systems Inc. (United States)
Canon Research Center America Inc. (United States)
Canon U.S.A. Inc. (United States)
Canon Virginia Inc. (United States)
C.S. Polymer Inc. (United States)
Dupli-fax Inc. (United States)
MCS Business Machines Inc. (United States)
O.E. Inc. (Canada)
Southtech Inc. (United States)
United Solar Systems Corporation (United States)

Europe

Canon Benelux Foto B.V. (Netherlands)
Canon Bretagne S.A. (France)
Canon Business Machines Belgium N.V./S.A. (Belgium)

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Canon Business Machines Nederland B.V. (Netherlands)
Canon Deutschland GmbH (Germany)
Canon Espana S.A. (Spain)
Canon Europa N.V. (Netherlands)
Canon Euro-Photo Handelsgesellschaft m.b.H. (Germany)
Canon France S.A. (France)
Canon Geselischaft m.b.H. (Austria)
Canon Giessen GmbH (Germany)
Canon Information Systems R&D Europa S.A. (France)
Canon Italia S.p.A. (Italy)
Canon Manufacturing U.K. Ltd. (United Kingdom)
Canon (Mersey) Business Machines Ltd. (United Kingdom)
Canon Photo Video France S.A. (France)
Canon Research Centre Europe Ltd. (United Kingdom)
Canon S.A./A.G. (Switzerland)
Canon Scotland Business Machines Ltd. (United Kingdom)
Canon (South-West) Ltd. (United Kingdom)
Canon Svenska AB (Sweden)
Canon (UK) Ltd. (United Kingdom)
Olivetti-Canon Industriale S.p.A. (Italy)
Oy Canon Ab (Finland)
Selex France S.A. (France)
Symat Business Management Ltd. (United Kingdom)

Japan

Canon Aptex Inc. (Japan)
Canon Chemical Co. Inc. (Japan)
Canon Components Inc. (Japan)
Canon Copyer Sales Co. Ltd. (Japan)
Canon Electronics Inc. (Japan)
Canon Precision Inc. (Japan)
Canon Sales Co. Inc. (Japan)
Canon Seiko Co. Inc. (Japan)
Canon Software Inc. (Japan)
Copyer Co. Ltd. (Japan)
Fast Net Inc. (Japan)
Nagahama Canon Inc. (Japan)
Nippon Typewriter Co. Ltd. (Japan)
Oita Canon Inc. (Japan)
Optron Inc. (Japan)

ROW

Canon Australia Pty. Ltd. (Australia)
Canon Business Machines de Mexico S.A. de C.V. (Mexico)
Canon Camera (Malaysia) Sdn. Bhd. (Malaysia)
Canon Dalian Business Machines Inc. (China)
Canon do Brasil Industria e Comercio Limitada (Brazil)
Canon Engineering Singapore Pte. Ltd. (Singapore)
Canon Finance Australia Ltd. (Australia)
Canon Hi-Tech (Thailand) Ltd. (Thailand)
Canon Hong Kong Trading Co. Ltd. (Hong Kong)
Canon Inc. (Taiwan)
Canon Information Systems Research Australia Pty. Ltd. (Australia)
Canon Latin America Inc. (Panama)
Canon Latinoamerica de Mexico S.A. de C.V. (Mexico)
Canon Marketing (Malaysia) Sdn. Bhd. (Malaysia)
Canon Marketing Services Pte. Ltd. (Singapore)
Canon New Zealand Ltd. (New Zealand)
Canon Opto (Malaysia) Sdn. Bhd. (Malaysia)
Canon Panama S.A. (Panama)
Canon Singapore Pte. Ltd. (Singapore)
Canon Zhuhai, Inc. (China)
Lotte Canon Co., Ltd. (Korea)

ALLIANCES, JOINT VENTURES, LICENSING AGREEMENTS

1991

Apple Computer Inc.
Canon will supply its BJ-10 bubble jet printer for Apple's Macintosh computer on an OEM basis. Canon has been the supplier of Macintosh laser printers to Apple on an OEM basis.

Cray Research Inc.
Cray signed a dealership agreement with Canon under which Canon will market Cray's entry-level supercomputer called the Y-MP2E.

Hewlett-Packard Company (HP)
Canon will market HP's NewWave software tool which integrates different types of personal computers. NewWave allows a wide range of application software, developed for different PCs, to appear to operate in similar ways. The software runs on a variety of operating systems including MS-Windows, OS/2, and UNIX, regardless of the hardware involved. In a related move, Canon announced it will supply Fujitsu Ltd., IBM Corporation, and NEC Corporation with the NewWave software tool on an OEM basis.

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Hewlett-Packard Company, the Singapore Economic Development Board, and Texas Instruments Incorporated (TI)

The four companies will jointly construct and own a $330 million wafer fab plant, to be located in Singapore and called TECH Semiconductor Singapore Pte. Ltd. The new plant will use submicron CMOS manufacturing technology to produce DRAMs and possible logic chips. TI and the Singapore Economic Development Board each will own 26 percent of the new firm, while Canon and HP each will own 24 percent.

IBM Corporation

IBM will license personal computer technologies to Canon and 10 other Japanese companies to allow them to produce PCs that are fully compatible with IBM computers.

Sanyo Electric Inc.

The two companies signed a marketing agreement under which Sanyo's notebook 286 PC, called the MBC-17NB, will be sold together with Canon's portable bubble jet printer, called the BJ-10E.

1990

AT&T Company

Canon U.S.A. Inc. signed a comarketing agreement with AT&T whereby the two companies will jointly address opportunities in the Group 4 facsimile and 56 Kbps switched digital services markets. This agreement marks the first comarketing venture to target the new generation of facsimile users.

Hewlett-Packard Company

Canon will license its bubble jet computer printer technology to HP.

Robert Bosch GmbH

In an attempt to boost its business operations in Europe, Canon will supply an electronic still image camera compatible with the PAL system to Robert Bosch of Germany on an OEM basis. Robert Bosch will begin marketing the camera, which can record up to 50 images on a 2-inch floppy disk, starting in the second quarter of 1991.

1989

NeXT Incorporated

Canon agreed to be the exclusive distributor of NeXT computers in Asia.

Software Limited

Software Limited agreed to distribute Canon's LBP-4 and LPB-8 III laser printers, as well as the BJ-130 bubble jet printer, in the United Kingdom.

Hewlett-Packard Company

Canon and Hewlett-Packard agreed to codevelop the specifications for a Japanese language version of the HP NewWave software.

Hitachi Ltd.

Canon agreed to market Hitachi's high-capacity private branch exchanges in combination with its own Office Automation equipment.

Adobe Systems Incorporated

Canon licensed the Adobe Systems PostScript interpreter to implement into its own line of printers.

1988

Eastman Kodak Company

Canon agreed to supply copiers and medical equipment to Eastman Kodak.

Intel Corporation

Canon and Intel agreed to jointly develop specialized large-scale integration for copiers. Canon has cosigned production to Intel.

Nippon Typewriter Co. Ltd.

Nippon commissioned the production of Canon's LBP-ST, a compact laser printer.

Ricoh Co. Ltd.

The two companies agreed to supply each other on an OEM basis with plain paper copiers in order to supplement their respective copier lines.

Computer Automation

Canon acquired the patent rights for micro channel technology from Computer Automation.

MERGERS AND ACQUISITIONS

1990

Cymer Laser Technologies Corporation

Canon invested US$700,000 in Cymer, a developer of an excimer laser that projects circuit patterns onto silicon wafers. The equity purchase represents less than a 2.5 percent interest.

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Interactive Media Technologies Inc.
Canon Sales Co. Inc., a Japanese subsidiary of Canon, acquired a 10 percent stake in Scottsdale, Arizona-based Interactive Media Technologies and 9.9 percent of the company's Interactive Media Intelligence Technologies Inc. subsidiary. Interactive Media's major product is the IMTX 8000 media integration system, claimed to be world's first hardware-software multimedia system.

Novell Inc.
Canon purchased a 4 percent share in Novell K.K., a Japanese subsidiary of Novell Inc.

O.E. Inc.
Canon acquired O.E. Inc., the largest Canadian dealer in business machines.

1989

NeXT Incorporated
Canon purchased a 16.7 percent interest in NeXT stock, valued at $100 million.

KEY OFFICERS

Ryuzaburo Kaku
Chairman and representative director

Dr. Keizo Yamaji
President and representative director

Hajime Mitarai
Director, Research and Development

Kazuo Naito
Director, Photo Products

Hiroshi Tanaka
Director, Business Machines Products

Fujio Mitarai
Director, Corporate Administration

Masahiro Tanaka
President, Canon Europe N.V.

Hideharo Takemoto
President, Canon U.S.A. Inc.

Tsuneo Enome
Director, Production Management

Giichi Marushima
Director, Law and Intellectual Property

Yoshiaki Suguri
Senior general manager, General Affairs and Corporate Communications

Seiichi Takikawa
President, Canon Sales Co. Inc.

PRINCIPAL INVESTORS

Dai-Ichi Mutual Life Insurance Co.—6.8 percent

FOUNDERS

Information is not available.

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Table 3
Balance Sheet
Fiscal Year Ending in December
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash	808.7	1,754.0	3,036.3	3,726.9.	3,321.3
Receivables	1,005.6	1,134.8	1,514.1	1,757.3	1,942.1
Marketable Securities	736.4	1,070.0	412.8	210.5	209.1
Inventory	1,478.3	1,525.3	2,169.5	2,493.3	2,677.2
Other Current Assets	223.3	265.0	372.8	538.6	649.8
Total Current Assets	4,252.3	5,749.2	7,505.5	8,726.7	8,799.5
Net Property, Plants	1,377.5	1,643.3	2,001.2	2,190.3	2,473.5
Other Assets	379.1	481.7	648.4	940.9	1,333.5
Total Assets	6,009.0	7,874.2	10,155.0	11,857.8	12,606.5
Total Current Liabilities	2,689.2	3,329.7	4,699.7	5,169.6	5,817.1
Long-Term Debt	992.4	1,547.1	1,610.0	2,011.3	1,813.0
Other Liabilities	65.0	75.8	85.0	82.9	77.0
Total Liabilities	3,746.6	4,952.6	6,394.7	7,263.8	7,707.2
Converted Preferred Stock	-	-	-	-	-
Common Stock	182.9	249.1	339.0	528.8	561.4
Other Equity	942.7	1,335.9	1,576.6	1,902.7	1,884.9
Retained Earnings	993.7	1,199.8	1,577.1	1,668.5	1,931.2
Currency Adjustments	(116.6)	(207.0)	(239.0)	(108.5)	(118.5)
Total Shareholders' Equity	2,002.7	2,577.8	3,253.6	3,991.6	4,259.1
Minority Interest	259.7	343.8	506.7	602.4	640.3
Total Liabilities and Shareholders' Equity	6,009.0	7,874.2	10,155.0	11,857.8	12,606.5
Exchange Rate (US$1=¥)	168	144	128	138	145

Source: Canon Incorporated
Annual Reports and Forms 10-K
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Table 4
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	5,293.0	6,782.7	8,640.7	9,789.3	11,916.9
Japanese	1,632.0	2,016.5	2,722.4	2,998.9	3,508.6
Non-Japanese	3,661.0	4,766.2	5,918.3	6,790.3	8,408.3
Cost of Sales	3,167.0	4,112.3	5,009.2	5,581.1	6,654.2
R&D Expense	329.3	396.4	511.9	547.6	593.2
SG&A Expense	1,947.1	2,348.8	2,944.6	3,367.7	4,167.6
Capital Expense	483.8	441.0	649.0	777.5	946.9
Pretax Income	165.2	279.4	670.5	660.1	1,066.2
Pretax Margin (%)	3.12	4.12	7.76	6.74	8.95
Effective Tax Rate (%)	64.60	62.70	51.10	50.80	55.80
Net Income	63.9	91.8	289.8	277.5	423.5
Shares Outstanding, Thousands	746,108	747,053	747,059	780,546	788,765
Per Share Data					
Earnings	0.10	0.14	0.40	0.36	0.54
Dividend	0.07	0.06	0.09	0.09	0.09
Book Value	2.68	3.45	4.36	5.11	5.40
Exchange Rate (US$1=¥)	168	144	128	138	145

Source: Canon Incorporated
Annual Reports and Forms 10-K
Dataquest (October 1991)

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Table 5
Balance Sheet
Fiscal Year Ending in December
(Millions of Yen)

Balance Sheet	1986	1987	1988	1989	1990
Cash	135,860	252,576	388,645	514,312	481,595
Receivables	168,946	163,410	193,800	242,511	281,607
Marketable Securities	123,717	154,085	52,843	29,052	30,318
Inventory	248,349	219,649	277,691	344,077	388,187
Other Current Assets	37,521	38,158	47,720	74,331	94,221
Total Current Assets	714,393	827,878	960,699	1,204,283	1,275,928
Net Property, Plants	231,242	236,637	256,151	302,258	358,656
Other Assets	63,687	69,366	82,993	129,839	193,361
Total Assets	1,009,504	1,133,881	1,299,843	1,636,380	1,827,945
Total Current Liabilities	451,780	479,483	601,562	713,399	843,484
Long-Term Debt	166,722	222,784	206,083	277,556	262,886
Other Liabilities	10,921	10,908	10,879	11,447	11,170
Total Liabilities	629,423	713,175	818,524	1,002,402	1,117,540
Common Stock	30,728	35,873	43,386	72,979	81,408
Other Equity	158,377	192,370	201,810	262,577	273,307
Retained Earnings	166,947	172,766	201,866	230,252	280,027
Currency Adjustments	(19,596)	(29,811)	(30,597)	(14,967)	(17,176)
Total Shareholders' Equity	336,456	371,198	416,465	550,841	617,566
Minority Interest	43,625	49,508	64,854	83,137	92,839
Total Liabilities and Shareholders' Equity	1,009,504	1,133,881	1,299,843	1,636,380	1,827,945
Exchange Rate (US$1=¥)	168	144	128	138	145

Source: Canon Incorporated
Annual Reports and Forms 10-K
Dataquest (October 1991)

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Table 6
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of Yen, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	889,217	976,711	1,106,010	1,350,917	1,727,948
Japanese	274,174	290,382	348,462	413,854	508,747
Non-Japanese	615,043	686,329	757,548	937,063	1,219,201
Cost of Sales	532,048	592,174	641,181	770,185	964,852
R&D Expense	55,330	57,085	65,522	75,566	86,008
SG&A Expense	327,108	338,231	376,915	464,747	604,296
Capital Expense	81,273	63,497	83,069	107,290	137,298
Pretax Income	27,759	40,237	85,829	91,091	154,597
Pretax Margin (%)	3.12	4.12	7.76	6.74	8.95
Effective Tax Rate (%)	64.60	62.70	51.10	50.80	55.80
Net Income	10,728	13,224	37,100	38,293	61,408
Shares Outstanding, Thousands	746,108	747,053	747,059	780,546	788,765
Per Share Data					
Earnings	16.67	19.65	51.27	50.16	78.29
Dividend	11.36	9.09	11.36	11.93	12.50
Book Value	450.95	496.88	557.47	705.71	782.95
Exchange Rate (US$1=¥)	168	144	128	138	145

Source: Canon Incorporated
Annual Reports and Forms 10-K
Dataquest (October 1991)

Table 7
Key Financial Ratios
Fiscal Year Ending in December

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	1.58	1.73	1.60	1.69	1.51
Total Assets/Equity (%)	300.04	305.47	312.11	297.07	295.99
Current Liabilities/Equity (%)	134.28	129.17	144.44	129.51	136.58
Total Liabilities/Equity (%)	187.07	192.13	196.54	181.80	180.96
Profitability (%)					
Return on Assets	1.06	1.17	2.85	2.34	3.36
Return on Equity	3.19	3.56	8.91	6.95	9.94
Profit Margin	1.21	1.35	3.35	2.83	3.55
Other Key Ratios					
R&D Spending % of Revenue	6.22	5.84	5.92	5.59	4.98
Capital Spending % of Revenue	9.14	6.50	7.51	7.94	7.95
Employees	35,498	37,521	40,740	44,401	54,381
Revenue (¥K)/Employee	25,050	26,031	27,148	30,425	31,775
Capital Spending % of Assets	8.05	5.60	6.39	6.56	7.51
Exchange Rate (US$1=¥)	168	144	128	138	145

Source: Canon Incorporated
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Digital Equipment Corporation

146 Main Street
Maynard, Massachusetts 01754
Telephone: (508) 897-5111
Fax: (508) 493-8780
Dun's Number: 00-103-8066

Date Founded: August 23, 1957

CORPORATE STRATEGIC DIRECTION

Digital Equipment Corporation was founded by Kenneth Olsen and Harland Anderson, two former employees of MIT's Lincoln Laboratory. Digital has grown from its origin as a manufacturer of computer logic modules into one of the largest computer manufacturers in the United States. Digital is a leading supplier of networked computer systems, minicomputer systems, software, and services, including systems integration.

Digital designs, manufactures, and sells a variety of hardware and software products that integrate personal computers into local and wide area networks and interconnect networked personal computers with departmental and mainframe Digital and IBM systems. The company also manufactures and sells data storage and associated peripheral devices, which are used with and sold as part of the company's various computer systems. These devices include magnetic tape transports, tape cassette and disk storage devices, cathode ray tube display systems, analog to digital converters, terminals, and line printers. Selected peripherals and components are also sold separately for other independent applications to other system and peripheral equipment manufacturers. The company is a major manufacturer and supplier of video terminals and buys selected personal computer and peripheral equipment from other manufacturers for use with its own computer systems.

Today, Digital is offering a complete line of systems from networked PCs to mainframes. The company's product and marketing strategy is that Digital is in four businesses: offering commodity products that are standard in the industry; offering VAX systems that meet all common standards; offering systems integration; and offering a wide range of services for its customers. Digital's emphasis for the 1990s is on an extension of its multivendor integration strategy, which is to combine Digital's broad range of products with those supplied by other vendors to provide the user with a complete computing solution.

In fiscal year 1990, the company began a series of restructuring actions to improve its cost structure, including absorbing a restructuring charge of $550 million.* This restructuring charge covered the cost of employee separations, retraining and relocation, facility consolidations, retirement of equipment, and related administrative costs.

During fiscal 1991, Digital had a $617 million loss, which included a $1.1 billion restructuring charge. According to Digital, this restructuring charge was needed to close facilities and reduce staff. The company, however, did not cut back on investments in computer technology.

Digital's total revenue increased 7.48 percent to $13.9 billion for the fiscal year ended June 29, 1991, compared with $12.9 billion in fiscal 1990. All of the company's growth occurred in its overseas operations. Net income decreased to negative $617 million in fiscal 1991, in comparison with $74 million in fiscal 1990. According to Digital, these results reflect intense price competition throughout the industry because of the recession, compounded by dramatic improvements in the performance of computers.

The company introduced a number of new computer systems for both UNIX and the company's own VMS operating systems, as well as a broad range of multivendor client/server software, service, and hardware products. In addition, the company increased the performance and functionality of its systems and lowered its prices on many products, thereby improving price/performance.

*All dollar amounts are in U.S. dollars.

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North America represented 40 percent of Digital's total revenue, while Europe accounted for almost 45 percent of total revenue. In fiscal 1991, almost 60 percent of Digital's revenue came from foreign markets. Digital has approximately 500 worldwide sales offices, 53 percent of which are located in the United States.

R&D expenditure increased 2 percent and represented 11.85 percent of total revenue. Total R&D investment for fiscal 1991 was $1,649 million, compared with $1,614 million in fiscal 1990. R&D activities include developing or enhancing systems, related peripheral equipment and software, and expanding product applications and multivendor systems integration.

Capital expenditure decreased from $1,028 million in 1990 to $738 million in 1991, which represented 5.3 percent of revenue. Much of this investment was focused on improving manufacturing and engineering efficiency and advancing employee productivity throughout the organization. Approximately 69 percent of the current year's total was spent for machinery and equipment; the balance was for buildings, leasehold improvements, and land.

In January 1991, Digital acquired from Mannesmann AG 65 percent of its Mannesmann Kienzle Computer Systems Division, along with the PROCAD GmbH and PCS GmbH divisions of Mannesmann Kienzle. The name of the new company is Digital-Kienzle Computersysteme GmbH & Co. K.G. Digital's investment in Digital-Kienzle was $233 million. According to Digital, this investment advances the company's strategic thrust in selling to small and medium-size businesses worldwide and complements a series of new products, services, and channels for small and medium-size businesses announced by the company during fiscal 1991. This investment also complements the company's development and support of UNIX-based applications and enhances the company's position in selling into emerging markets in central and eastern Europe.

In addition, shortly after the close of fiscal 1991, Digital reached an agreement in principle with Philips Electronics N.V. of the Netherlands to acquire most of the Philips' Information Systems Division, subject to receipt of necessary regulatory approvals and negotiation and execution of final agreements.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 5 at the end of this backgrounder provide comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Technical Computers

For the year ended December 31, 1990, Dataquest estimated Digital's worldwide factory revenue market share to be 20.51 percent for the total technical computer market. This places Digital in the No. 1 position in this market, with revenue of $3,695 million.

In the supercomputer market, Dataquest ranked Digital sixth with a market share of 3.09 percent and revenue of $53.3 million; in the mainframe market, Digital ranked tenth with a market share of 1.18 percent and revenue of $50.4 million; in the midrange market, Digital ranked first with a market share of 46.33 and revenue of $2.4 billion.

During fiscal 1990, Digital introduced the VAX 9000 mainframe, the VAX 4000 system, and vector processing capabilities for the VAX 9000 and the VAX 6000 systems. During fiscal 1991, more than 330 VAX 9000 systems were shipped to customers and over 15,000 VAX 6000 systems were sold. In October 1991, Digital announced new versions of the VAX 4000 and VAX 6000 systems.

Business Computers

In business markets and applications, Dataquest ranked Digital as follows: in the midrange market, it ranked second with a market share of 7.19 percent and revenue of $1.7 billion; and in the workstation market, it ranked second with a market share of 24.27 percent and revenue of $149.5 million.

In August 1991, Digital introduced a family of computers based on massively parallel processing (MPP), a high-performance technology targeted at very complex problems of technical, scientific, and commercial users. The new DECmpp 12000 system series will be supplied by MasPar Computer Corporation.

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Microcomputer Systems

In May 1991, Digital introduced a series of the DECpc product line. The "T" series deskside systems are being positioned as a combination of PC and server products; the "N" series of products are being aimed at windowing- and graphics-oriented network clients; the "D" series are general-purpose desktop systems; and the "P" series units are portable products: notebooks and laptops.

Digital also introduced the world's first true PC-workstation crossover product. The DECpc 433 Workstation is not a true workstation in the sense that it is not built on a RISC processor architecture, nor is it a true PC because it features many capabilities not presently found in the PC market. This product can perform many of the graphics-oriented functions normally associated with true workstations and yet provide the end-user community access to the more than 32,000 DOS-based applications.

Dataquest believes that Digital's reentry into the world of PCs will be a successful one, not only because of the breadth and depth of these new products, but also because the 433 Workstation is the first implementation of a true PC-workstation crossover product. The development of this type of product indicates that Digital now understands not only the minicomputer and workstation marketplace, but also the importance that the PC plays and will continue to play in the world of corporate computing.

Software

Digital provides several operating system environments including MS-DOS, UNIX, and VMS. Digital incorporated UNIX into its technical computer products in 1983 and currently offers users of both business and technical systems choices between VMS and ULTRIX (Digital's version of the UNIX operating system).

Digital has worked closely with other hardware and software vendors to develop guidelines for an open systems environment, and the ULTRIX software is compliant with open systems standards developed by the Open Software Foundation. ULTRIX also is an integral part of Network Application Support, Digital's plan for application integration in a distributed, multivendor environment.

Although VMS software supports most of the same open systems standards as the UNIX operating systems, the VMS environment supports vector processing, clustering, symmetrical multiprocessing, and other capabilities not commonly found on UNIX operating systems, but which are critical in high-volume production data processing environments.

Digital and more than two hundred other computer companies including Compaq, Microsoft, MIPS Computer Systems, and The Santa Cruz Operation have agreed on a common set of standards that will enable high-performance desktop computers and workstations from different manufacturers to run the same software. This initiative addresses both personal computers and workstations—and both hardware and software—so there will no longer be disconnects among desktop systems.

Telecommunications

Digital has incorporated a standard for local area networks, for public packet-switching networks, for communicating with UNIX and IBM systems, and for long-distance data transmission over telephone networks into ADVANTAGE-NETWORKS. It integrates Open Systems Interconnection (OSI), transmission control protocol/internet protocol (TCP/IP), and DECnet protocols to provide the infrastructure needed to connect personal computer networks, ethernet and token-ring local area networks, SNA networks, Novell networks, and public and private wide area networks to support distributed applications, client/server computing, and inter-enterprise communications.

According to Dataquest, Digital is the worldwide leading industry vendor of ethernet-based LANs. Approximately 725,000 DECnet nodes are in operation at sites all over the world. Although DEC's existing support is based on DECnet and TCP/IP, the company will refocus its communications support to the OSI model in releases of DECnet/OSI for ULTRIX and VMS.

Display Terminals

According to Dataquest estimates, Digital had 8.0 percent of the market share in the worldwide display terminal market in calendar year 1990, with shipments of 510,000 units. Current products include the VT420 Text Terminal, the VT330+ text/graphics terminal, the VT340 terminal, the VT1200 X Window System display terminal, the DECimage 1200 display terminal, and the VT1300 color X Window System terminal. According to Dataquest, Digital is the third-largest manufacturer of desktop units in the world, trailing only Wyse Technology Inc. (including Link)

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and IBM in terminal sales volume.

Printers

Digital's worldwide printer strategy is to provide a comprehensive range of user solutions regardless of user applications or operating systems. It is following through on this strategy by buying print engines from other vendors and then enhancing or adding value to the product. The company adds value by providing user transparency through DECPrint, paper handling, and user-service ability.

In October 1991, Digital and Printronix Inc. celebrated the first shipments of their jointly developed LG06 Line Matrix printer. By teaming up with Printronix, Digital has tapped into Printronix line matrix printing technology as well as the printer company's experience and expertise in bar code applications. In addition to featuring reliable text and graphics printing for business applications, the LG06 supports 13 bar code symbologies for increased productivity.

CAD/CAM/CAE

According to Dataquest, Digital's worldwide market share of the CAD/CAM/CAE electronic design automation market in calendar 1990 was 7.3 percent, based on end-user revenue (OEM revenue excluded). The company's market share for hardware was 11 percent and software 3 percent. Digital's actual 1990 revenue for this market was $230.3 million, with hardware accounting for $163.9 million and software $3.9 million. The actual shipment of workstations during this period was 1,941.

Digital's strategy in the CAD/CAM/CAE market is to develop strategic relationships with key vendors of software applications and create pull-through demand for the Digital hardware platform. Digital continues to build these relationships and has developed the System Cooperative Marketing Program and the Cooperative Marketing Program to focus on applications development.

Computer Storage

In 1990, Digital maintained its first place ranking in the total worldwide 1/2-inch tape drive market with 27.9 percent market share, based on unit shipments. Digital also ranked first in the worldwide total 1/2-inch cartridge market with a 46.0 percent market share, based on unit shipments. The company ranked seventh in worldwide total tape drives, with a market share of 6.2 percent.

In November 1991, Digital and Tandberg Data Inc. announced that Tandberg Data's 525MB TDC tape drive, using linear scan quarter-inch cartridge (QIC) technology, will be used in a new series of tape backup products supplied by Digital for the PC market. The 525MB QIC tape backup system from Digital is part of a new initiative in the DECpc 433 product line and is compatible with desktop and tower products.

In September 1991, Cipher Data Products Inc. (a subsidiary of Archive Corporation) and Digital signed a business alliance. The companies will develop a new range of high-performance tape drives that will be compatible with all major hardware families. The drives will be based around DEC's TF857. The drives are being designed to give storage capacities of 2.6GB per cartridge, with a total unattended storage capacity of 18.2Gb, using an automatic cartridge loader.

In August 1991, Digital converted its mass-storage plant in Colorado Springs, Colorado, from large-diameter, centralized hard disk drive subsystems to concentrate on 2-1/2- and 3-1/2-inch drives for desktop and laptop systems. Digital intends to move production of the large-diameter, centralized hard disk drive subsystems to a plant in Kaufbeuren, Germany, by July 1992.

Further Information

For further information about the company's business segments, please contact the appropriate industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1987	1988	1989	1990	1991
Five-Year Revenue	9,389	11,475	12,742	12,943	13,911
Percent Change	23.70	22.22	11.04	1.58	7.48
Capital Expenditure	748	1,518	1,223	1,028	738
Percent of Revenue	7.97	13.23	9.60	7.94	5.31
R&D Expenditure	1,010	1,307	1,525	1,614	1,649
Percent of Revenue	10.76	11.39	11.97	12.47	11.85
Number of Employees	110,500	121,500	125,800	124,000	121,000
Revenue ($K)/Employee	84.97	94.44	101.29	104.38	114.97
Net Income	1,137	1,306	1,073	74	(617)
Percent Change	84.28	14.86	(17.84)	(93.10)	(933.78)

1991 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	3,093	3,353	3,520	3,945
Quarterly Profit	26	111	117	(871)

Source: Digital Equipment Corporation
Annual Reports
Dataquest (December 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1987	1988	1989	1990	1991
North America	53.40	50.60	45.91	45.00	40.16
Europe	34.60	36.80	40.26	40.51	44.68
Japan, Asia/Pacific, and ROW	12.00	12.60	13.83	14.49	15.16

Source: Digital Equipment Corporation
Annual Reports
Dataquest (December 1991)

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1991 SALES AND SERVICE OFFICE LOCATIONS

North America—263
Japan—29
Europe—117
Asia/Pacific—31
ROW—54

MANUFACTURING LOCATIONS

North America

Albuquerque, New Mexico
  Video displays
Augusta, Maine
  CPU expansion cabinets
Boston, Massachusetts
  Keyboards
Burlington, Vermont
  Computers
Colorado Springs, Colorado
  Disk drives
Greenville, South Carolina
  Printed wiring boards
Hudson, Massachusetts
  Custom ICs, network interface boards
Kanata, Q.A., Canada
  Computers, backplanes, subassemblies
Maynard, Massachusetts
  Module production
Salem, New Hampshire
  Special systems
Shrewsbury, Massachusetts
  Thin film heads, disk and tape drives
Springfield, Massachusetts
  Disk drives
Westfield, Massachusetts
  Computers
Westminster, Massachusetts
  Software

Japan

  Computer Systems

Europe

Ayr, Scotland
  Components, subassemblies
Galway, Ireland
  VAX systems and supplies
Kaufbeuren, West Germany
  Storage arrays
South Queensferry, Scotland
  Custom ICs
Valbonne, France
  Terminals

Asia/Pacific

Hong Kong
  Terminals
Singapore
  Disk drives, heads
Tachi, Taiwan
  Terminals

ROW

Aguadilla, Puerto Rico
  CPU manufacturing, printed wiring boards
Chihuahua, Mexico
  Power supplies
San German, Puerto Rico
  Electronic cards

SUBSIDIARIES

North America

Computer Insurance Company Limited
Digital Equipment Caribbean Inc. (United States)
Digital Equipment Co. Limited (United States)
Digital Equipment Corporation International (United States)
Digital Equipment (DEC) Limited (United States)
Digital Equipment Filipinas Inc. (United States)
Digital Equipment Finance Corporation (United States)
Digital Equipment International Limited (United States)
Digital Equipment of Canada Limited/Digital Equipment Du Canada Limite (Canada)
Digital Equipment Services Inc. (United States)
Digital Growth Inc. (United States)
Digital Incorporated (United States)
Digital International Sales Corporation (United States)
Old Colony Insurance Ltd. (United States)

Japan

Nihon Digital Equipment Corporation KK

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Europe

Digital Equipment Aktiebolag (Sweden)
Digital Equipment Betriebliche Altersversorgungsgesellschaft GmbH (Germany)
Digital Equipment B.V. (Netherlands)
Digital Equipment Centre Technique (Europe) SARL
Digital Equipment Corporation A/S (Denmark)
Digital Equipment Corporation A/S (Norway)
Digital Equipment Corporation Espana S.A. (Spain)
Digital Equipment Corporation Finance B.V. (Netherlands)
Digital Equipment Corporation Gesellschaft GmbH (Germany)
Digital Equipment Corporation International (Europe)
Digital Equipment Corporation Ireland Limited (Ireland)
Digital Equipment Corporation Oy (Finland)
Digital Equipment Corporation S.A./A/G (Germany)
Digital Equipment Corporation Services (Europe)
Digital Equipment Foreign Sales Corporation B.V. (Netherlands)
Digital Equipment France (France)
Digital Equipment GmbH (West Germany)
Digital Equipment Hellas Ltd. (Greece)
Digital Equipment (Holdings) B.V. (Netherlands)
Digital Equipment International B.V. (Netherlands)
Digital Equipment International GmbH (Germany)
Digital Equipment N.V./S.A. (Belgium)
Digital Equipment Overseas Finance N.V. (Netherlands)
Digital Equipment Parts Center B.V. (Netherlands)
Digital Equipment PLC Limited (United Kingdom)
Digital Equipment Portugal, Limitada (Portugal)
Digital Equipment Scotland Limited (Scotland)
Digital Equipment S.p.A. (Italy)

Asia/Pacific

Digital Computer Taiwan Limited (Taiwan)
Digital Equipment China Inc. (China)
Digital Equipment Corporation Limited (New Zealand)
Digital Equipment Corporation Pty. Ltd. (Australia)
Digital Equipment Hong Kong Limited (Hong Kong)
Digital Equipment Inc. (Korea)
Digital Equipment Sdn. Bhd. (Malaysia)
Digital Equipment Singapore (Pte.) Limited (Singapore)
Digital Equipment Ltd. (Thailand)
Digital Equipment Taiwan Limited (Taiwan)

ROW

Digital Equipment Corporation de Puerto Rico (Puerto Rico)
Digital Equipment de Brazil Ltda. (Brazil)
Digital Equipment (DEC) Technical Center Limited (Israel)
Digital Equipment de Mexico S.A. De C.V. (Mexico)
Digital Equipment Panama Inc. (Panama)
Kam Hon Development Company Limited

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Silicon Graphics
Silicon Graphics licensed its graphics software, the IRIS Graphics Library, to Digital.

Mannesmann Kienzle GmbH
Mannesmann Kienzle GmbH (a subsidiary of Mannesmann AG) sold its data systems activity to Digital for $230 million. The sale will involve the two companies forming a joint venture in the computer business, with Digital owning 65 percent and Mannesmann owning the remaining 35 percent of a new company that will be called Digital-Kienzle Computersysteme GmbH & Co. K.G.

LM Ericsson Telephone
LM Ericsson Telephone and Digital signed a cooperation agreement on radio data communication linked to the Mobitex system. Digital will distribute Ericsson equipment for the Mobitex network and will provide systems integration services to customers. Mobitex is a radio network that allows communication with a computer network through a portable computer. Both companies will develop software tools to aid in the integration of Digital's products into the network.

Cipher Data Products Inc.
Cipher Data Products (a subsidiary of Archive Corporation) and Digital signed a business alliance. As part of the alliance, Cipher will adapt and customize Digital's high-performance, high-capacity 5.25-inch tape drive and market it under the Cipher name. Cipher will be the exclusive worldwide marketer of this product. Digital will try and sell the product to large OEMs for more private-labeling arrangements.

Adobe Systems Incorporated
Adobe Systems and Digital signed a licensing agreement for the DEC-fonts Typeface Collection. This agreement includes more than 1,000 fonts

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from the Adobe Type Library in the Adobe 1 Type format. The agreement will enable Digital to make fonts available to users of networked ULTRIX and VMS-based systems.

Poqet Computer Corporation
Poqet Computer Corporation and Digital signed an agreement to offer Mobiliser for ALL-IN-1 packages with the Poqet PC.

Sonda of Chile
Sonda of Chile and Digital have entered into a joint venture. The partnership involved selling U.S. software and software specifically tailored for Latin American needs.

Olivetti Systems & Networks
Olivetti Systems & Networks and Digital have signed a licensing agreement for Digital's Enterprise Management Architecture (EMA). The five-year licensing agreement will enable Olivetti to port Digital's DECmcc technology to UNIX System V Release 4.0. The agreement also includes Digital's Concert Multithread Architecture, DECmcc Director, and other management applications. Olivetti will use the technology to create PC LAN and network management packages.

Odesta Corporation
Odesta Corporation and Digital signed a licensing agreement. Under the terms of the agreement, Digital will distribute and support a future version of Odesta Document Management Systems, which are object-oriented work flow and document management systems.

Joint Marketing Alliances

Automated Systems Inc. (ASI)
Digital to supply workstations, networks; ASI to supply Prance GT software in a cooperative marketing program

Combustion Engineering
Plant systems joint marketing

Cullinet
Voice-processing products; VAX/IBM communications

Calma
MicroVAX II-based mechanical CAD systems

Cincinnati Bell
Billing management systems for cellular nets

Daisy Systems
MicroVAX II-based workstations for CAE

Datap
Marketing of real-time data management systems

The Eastman Kodak Company
Marketing of PostScript networked printer

Ericsson Systems
Integration and marketing of banking systems

Prime Computer Incorporated
VAX-based MEDUSA CAD/CAM systems

Tektronix Incorporated
MicroVAX II-based CAD/CAE systems

Technology Licensing Agreements

Elebra Computadores
License to manufacture VAX 11/750s in Brazil

Planar Systems
OEM agreement to resell EL flat panel displays

Relational Technologies
Bundling Ingres RDBMS with ULTRIX licenses

RSA Data Security
License for RSA data encryption and security software

Tandy Corporation
OEM agreement to resell Tandy PCs

Product Development Agreements

Alberta Telecom
Joint development of optic research projects

Allen-Bradley
Industrial control and management systems

Alcatel N.V.
Display terminals development

Apollo Computer Inc.
Joint development, licensing of NCS software

Apple Computer Inc.
DECnet-Appletalk communications interfaces

Ashton-Tate Corporation
Multiuser database product development

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CAI
Utility software development

Codex Corporation
Development of DEC EMA access modules

Cray Research Inc.
VAX/CRAY high-performance interface

Digital Comm Assoc.
Development of DEC EMA access modules

DSC Communications
Development of network service control systems

EDA Systems
Design management software

Evans & Sutherland
Development of workstation products

Insignia
VAXpc, PC emulation software running under VMS

Locus Computing
Connectivity software development

Lotus Development Corporation
VAX application software development

MIPS Computer Systems
OEM agreement to buy/manufacture MIPS RISC chip set

Motorola Incorporated
Jointly design a fiber-distributed data interface chip set

Northern Telecom Limited
Development of integrated voice/data products

Olivetti
PC-DECnet interface technology exchange

Open Software Foundation
UNIX development standards group

Phoenix Technologies Inc.
BIOS port to MicroVAX

Schlumberger Ltd.
Develop Bravo3 CAD/CAM software under VMS

Scientific Calc.
Digital minority interest in CAD software company

Siemens AG
Development of DEC EMA access modules and gateways for packetswitching

SPEC
Standards group for workstations and minis

Stratacom Inc.
Development of DEC EMA access modules

3Com Corporation
OS/2 and DOS connectivity to VAX/VMS

Timeplex Inc.
Development of DEC EMA access modules

TSB International
Development of DEC EMA access modules

Valid Logic System Inc.
CAD/CAE system software

Vitalink Communications Corporation
Remote LAN bridges; develop EMA access modules

X/Open
Software standards consortium

MERGERS AND ACQUISITIONS

Digital has made no recent mergers or acquisitions.

KEY OFFICERS

Kenneth H. Olsen
President

Winston R. Hindle, Jr.
Senior vice president

John F. Smith
Senior vice president, Engineering, Manufacturing, Product Marketing

Pier Carlo Falotti
Vice president, president, and CEO, Europe

FOUNDERS

Kenneth H. Olsen (MIT)
Harland Anderson (MIT)

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Table 3
Balance Sheet
Fiscal Year Ending in June
(Millions of U.S. Dollars)

Balance Sheet	1987	1988	1989	1990	1991
Cash	2,118	2,164	1,655	2,009	1,924
Receivables	2,312	2,592	2,965	3,207	3,317
Marketable Securities	0	0	0	0	0
Inventory	1,453	1,575	1,638	1,538	1,595
Other Current Assets	318	599	636	868	818
Total Current Assets	6,201	6,930	6,894	7,622	7,654
Net Property, Plants	2,127	3,095	3,646	3,868	3,778
Other Assets	79	87	128	165	443
Total Assets	8,407	10,112	10,668	11,655	11,875
Total Current Liabilities	1,825	2,414	2,394	3,290	4,091
Long-Term Debt	269	124	136	$150	150
Other Liabilities	20	63	102	$33	10
Total Liabilities	2,114	2,601	2,632	3,473	4,251
Converted Preferred Stock	0	0	0	0	0
Common Stock	130	130	130	130	130
Other Equity	1,753	1,917	1,540	1,795	2,149
Retained Earnings	4,410	5,464	6,366	6,257	5,345
Total Shareholders' Equity	6,293	7,511	8,036	8,182	7,624
Total Liabilities and Shareholders' Equity	8,407	10,112	10,668	11,655	11,875

Source: Digital Equipment Corporation
Annual Reports
Dataquest (December 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending in June
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	9,389	11,475	12,742	12,943	13,911
Domestic Revenue	4,976	5,746	7,952	7,743	7,787
Overseas Revenue	4,413	5,729	4,790	5,200	6,124
Cost of Sales	4,514	5,468	6,242	6,795	7,278
R&D Expense	1,010	1,307	1,525	1,614	1,649
SG&A Expense	2,253	3,066	3,639	3,971	4,471
Capital Expense	748	1,518	1,223	1,028	738
Pretax Income	1,689	1,740	1,421	124	520
Pretax Margin (%)	17.99	15.16	11.15	0.96	3.74
Effective Tax Rate (%)	32.70	25.00	24.50	40.00	18.80
Net Income	1,137	1,306	1,073	74	(617)
Shares Outstanding, Millions	133.3	131.9	122.0	123.0	125.0
Per Share Data					
Earnings	8.53	9.90	8.45	0.59	(5.08)
Dividend	0	0	0	0	0
Book Value	47.21	56.94	65.87	66.52	60.99

Source: Digital Equipment Corporation Annual Reports
Dataquest (December 1991)

Table 5
Key Financial Ratios
Fiscal Year Ending in June

Key Financial Ratios	1987	1988	1989	1990	1991
Liquidity					
Current (Times)	3.40	2.87	2.88	2.32	1.87
Total Assets/Equity (%)	133.59	134.63	132.74	142.44	155.76
Current Liabilities/Equity (%)	29.00	32.14	29.79	40.21	53.66
Total Liabilities/Equity (%)	33.59	34.63	32.75	42.45	55.76
Profitability (%)					
Return on Assets	13.52	12.92	10.06	0.63	(5.20)
Return on Equity	18.07	17.39	13.35	0.90	(8.09)
Profit Margin	12.11	11.38	8.42	0.57	(4.44)
Other Key Ratios					
R&D Spending % of Revenue	10.76	11.39	11.97	12.47	11.85
Capital Spending % of Revenue	7.97	13.23	9.60	7.94	5.31
Employees	110,500	121,500	125,800	124,000	121,000
Revenue ($K)/Employee	84.97	94.44	101.29	104.38	114.97
Capital Spending % of Assets	8.90	15.01	11.47	8.82	6.21

Source: Digital Equipment Corporation Annual Reports
Dataquest (December 1991)

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Fujitsu Limited

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Dun's Number: 08-292-1644

Date Founded: 1935

CORPORATE STRATEGIC DIRECTION

Fujitsu Limited, founded in 1935 as a spin-off of the Communications Division of Fuji Electric Company Ltd., is a multinational Japanese firm. Fujitsu designs, manufactures, and markets computers and information processing systems, telecommunications equipment, and electronic devices. To organize and unify such a diverse product offering, Fujitsu has segmented its corporate structure into the above-mentioned main divisions, as well as a category called "Other Operations," which includes electronic products such as car stereos, CD players, and digital audiotape players.

Although worldwide economic growth was slower than expected because of the Gulf War and a slowdown in U.S. and European economies, Fujitsu experienced a significant growth in business. The company had an increase of almost 18 percent in total revenue from $17.8 billion* in fiscal year 1990 to $21.0 billion in fiscal 1991. To achieve this growth, Fujitsu, as a total systems supplier, endeavored to offer a wide range of products from large-scale systems to personal equipment.

Almost 70 percent of Fujitsu's revenue was derived from the Computers and Information Processing Systems Division. The greatest focus in this division was on M Series general-purpose computers, UNIX open systems, and advanced value-added software services. Also showing considerable growth was the demand for office machines and personal equipment.

In the telecommunications field, Fujitsu supplied synchronous digital hierarchy (SDH) equipment to Nippon Telegraph and Telephone Corporation (NTT) in Japan and pioneered synchronous optical transmission (SONET) systems in the United States. In addition, the optical submarine cable system between the United Kingdom and Germany came nearer to completion, while the system between Japan and the United States went into operation.

Since the 1Mb DRAM market remained depressed in the world marketplace, business in electronic devices was difficult. Fujitsu, however, expanded the sales of its products in ASICs, microprocessors, and compound semiconductors.

According to Fujitsu, significant changes are occurring in the industry in downsizing, networks, and open systems. The company believes that these changes will define the technology that will be developed in the 1990s. Although downsizing has reduced their size and weight, products are being created with greater power and performance.

Fujitsu has continued to develop products that directly support International Service Digital Network (ISDN) and to offer Corporate Information Network System (COINS), which can be tailored to meet individual company needs. In addition, Fujitsu announced Multi-environment Information Systems Solution by Domain Concept (MISSION/DC), a domain-based mainframe concept that gives users the flexibility necessary to structure the systems they need. Fujitsu also announced a new approach to network system construction that offers a user-friendly connection to Fujitsu mainframes from workstations and PCs. This product is called MESSAGE 90s.

In the field of open systems, Fujitsu is promoting worldwide standardization of the UNIX operating system across industries, offering a full lineup of UNIX products from workstations to supercomputers. The company also developed the first operating system for mainframes and supercomputers to use UNIX System V Release 4. Other computers across the

*All dollar amounts are in U.S. dollars.

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Fujitsu product line will be developed to run under this operating system.

In 1990, Fujitsu took a major step toward increasing its global presence by acquiring an 80 percent share in ICL plc, a computer unit of STC plc. In January 1991, as the first joint project between the two companies, Fujitsu began the marketing of DS/90 UNIX server systems, developed by ICL and distributed through Fujitsu's overseas marketing network.

Research and development costs were 11.1 percent of revenue in fiscal 1991. This increase represents $2.3 billion as compared to $2.1 billion for 1990. R&D continues to be an important part of Fujitsu's future strategy. During fiscal 1991, the R&D funds were used to maintain the company's position as a pioneer in the competitive field of electronics. Future R&D products produced by Fujitsu will be more powerful and targeted at customer networks, especially at the low end such as hand-held PCs and cellular telephones.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 7, at the end of this backgroumder, present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Computers and Data Processing

The Computers and Information Processing Systems Division's net sales increased approximately 23.1 percent to $14.6 billion in fiscal 1991, accounting for 69 percent of the company's total net sales. This increase was mainly due to well-received mainframe systems, including the new M-1800 group of very-large-scale general-purpose computers, and to the strong performance of office machines and personal equipment in the domestic market, as well as the contribution of ICL.

Computer Systems

Within the computer systems product line, Fujitsu offers products from supercomputers to general-purpose computers. In August 1991, Fujitsu introduced two new models of the VP2000 Series supercomputers. The new systems, the VP2400/40 and VP2200/40, feature a four-scalar processor, two-vector processor configuration, which enables enhanced high-speed program processing.

In September 1990, Fujitsu announced the M-1800 Model Group of large-scale computers, which consists of five models. This was the first product introduction within the framework of MISSION/DC. Fujitsu plans to have the MISSION/DC be a major influence on its future product introductions.

According to Dataquest, in the worldwide business supercomputer market, Fujitsu ranks first with a 56.03 percent market share for 1990; in the worldwide technical supercomputer market, it ranks fourth with a 9.39 percent market share. In the worldwide business mainframe market, Fujitsu ranks fourth, with a 5.01 percent market share. In the worldwide technical mainframe market, it also ranks fourth with a 7.44 percent market share. Finally, in the worldwide business midrange market, Fujitsu ranks fifth with 5.56 percent of the market share.

Office Automation

Within the office automation product line, Fujitsu offers small business computers, workstations, word processors, and personal computers, including business, hypermedia, desktop, portable, and laptop. In the worldwide personal computer market, including desktop, portable, laptop, and notebooks, Fujitsu had less than 1 percent of the market share in each of these categories.

VAN Services

Within the VAN services product line, Fujitsu offers industry VANs, local VANs, corporate VANs, and personal communications services. During fiscal 1991, Fujitsu expanded the FENICS VAN service network, enhanced database services, and started FENICS-INS packet-switched services. To respond to the expansion of international VAN services in Asia, Fujitsu started a data switching service between Japan and Singapore. In addition, the NIFTY-Serve personal computer communications service was expanded to include English-to-Japanese machine translation, electronic mail, facsimile, and other services. As of March 31, 1991, this service has more than 260,000 subscribers.

Computer Storage

Fujitsu built its reputation in the rigid disk drive market with solutions for high-end computers. The

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company produces rigid disk drives in a variety of sizes from 2.5-inch to 14-inch. According to Dataquest, during 1990 Fujitsu ranked eighth in the worldwide overall total rigid disk drive market with a 2.9 percent market share. In the 8- to 14-inch worldwide rigid disk drive market, it ranked fourth with a 13.8 percent market share.

In September 1990, Fujitsu announced the M2671P, an 8-inch disk drive that provides 2.6GB of storage and offers a data transfer rate of 4.78 MB/sec. and a seek time of less than 12ms.

In September 1991, Fujitsu introduced a line of high-capacity, low-profile, 2.5-inch rigid disk drives. This product line consists of three disk drives all backed by a 150,000 hour mean time between failures rating, a comprehensive warranty program, and capacities of 45MB, 67MB, and 90MB. All four drives feature an average seek time of 18ms, burst data transfer rates of up to 6 MB/sec., and an average latency of 8.3ms.

Fujitsu also produces tape drives in 1/2-inch reel-to-reel, start-stop, and streaming. During calendar 1990, according to Dataquest, Fujitsu ranked fourth in the 1/2-inch worldwide tape drive market with a 9.0 percent market share. It also ranked fifth in the 1/2-inch worldwide reel-to-reel worldwide tape drive market with a 7.3 percent market share.

Electronic Printers

The company manufactures and markets line-impacted, fully formed printers, serial impact dot matrix printers, baud printers, and laser printers. According to Dataquest, during 1990 the company had less than 1 percent of the total worldwide printer market.

Software

Within the software product line, Fujitsu offers operating system software, application software, translation support systems, and architectures. In May 1991, MESSAGE 90s was introduced as a new approach to system construction. Its function is to help organizations process information effectively and set up systems quickly through linked software products. This product line allows the use of hardware and software from other vendors to be used in Fujitsu systems. For example, NEC or IBM PCs can run LOTUS 1-2-3 seamlessly in a Fujitsu-based network.

During fiscal 1991, Fujitsu strengthened System Development Architecture and Support facilities, with the SDEM90 standard method of system development and the C-NAP II/CASE technical support tool for analyzing system requirements. Also, to expand the computer-integrated manufacturing business, the company started consulting and basic planning services to support system structuring in the fields of production and product distribution.

Telecommunications

The Telecommunications Division's product line is ISDN systems, COINS, mobile communication, switching systems, and transmission systems. In fiscal 1991, the division recorded net sales of $3.1 billion, an increase of approximately 13 percent over fiscal 1990. Net sales of the division accounted for 15 percent of total net sales.

ISDN

NTT's new ISDN service INS net 64/1500 is achieving acceptance, and many users are applying the network to fit their applications. In fiscal 1991, the packet communications mode in INS net was approved and the new INS-P service was started. In addition, demand increased for the ISDN-compatible systems, which support the entire scope of these ISDN services.

COINS

COINS is a corporate information network system that is receiving significant interest from companies as a multimedia network with excellent economy and extendability. It integrates data, voice, and images. By the end of March 1991, Fujitsu had strengthened COINS to implement ISDN communications forms by adding 1.5Mb line-switching and packet-switching functions to conventional private ISDN functions.

Mobile Communication

Demand increased sharply for small, lightweight cellular telephones in the field of mobile communication. NTT is promoting development of very small and lightweight cellular telephones. Fujitsu is participating in this development under contract with NTT. In the U.S. cellular telephone handset market, Fujitsu ranked sixth with a 7.2 percent market share.

Switching Systems

Within the switching systems product line, Fujitsu offers central office switching systems and digital PBX switching systems. During fiscal 1991, Fujitsu developed and delivered a prototype of the next-generation node system for the D-70. For digital PBXs, the company added application packages to

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the series. Fujitsu also released the cost-effective E-100 Series of information switching systems. In the U.S. PBX systems market, with 1,000 plus lines (new), Fujitsu ranked sixth with a 2.5 percent market share. In the 101 to 400 lines (new) segment, the company ranked eighth with a market share of 2.5 percent.

Transmission Systems

Within the transmission systems product line, Fujitsu offers digital communications equipment and earth station systems for satellite communication. The company implemented SDH, an international standard that will open communications environments and enable ISDN and other new services to be used more efficiently. In Japan, NTT is actively promoting the conversion to SDH, while Fujitsu is delivering many transmission systems and radio equipment that comply with SDH.

Electronic Devices

The Electronic Devices Division includes IC memories, ASICs, compound semiconductors, and other electronic devices. Dataquest estimates that Fujitsu ranked sixth in the worldwide semiconductor market, with 4.9 percent of the market share and revenue totaling $2.9 billion during calendar year 1990. This includes captive sales, which are excluded from the Electronic Devices Division's sales, as reported in the annual report. Net sales within this division decreased by 1.0 percent from $2.49 billion to $2.47 billion. The division accounted for 12.0 percent of total net sales. The semiconductor product line can be segmented into IC memories (MOS and bipolar technology), ASICs (MOS and bipolar technology), large-scale integrations (LSIs), and electronic components.

IC Memories

In fiscal 1991, Fujitsu increased its production of 4Mb DRAMs. The company also started delivering samples of 16Mb DRAMs, which will be the next generation of computer memory. In February 1991, Fujitsu announced a prototype of a 64Mb DRAM that uses new photo lithography exposure technology. This new technology will make mass production possible. Also, in February 1991, Fujitsu announced the 4Mb BiCMOS ECL SRAM, with an access time of 7ns.

ASICs

In fiscal 1991, demand rose for faster and larger-scale CMOS gate arrays. To meet this demand, Fujitsu released 15 new products, 7 of which feature a gate delay of 0.5ns and contain up to 14,000 gates. The remaining eight feature a gate delay of 0.35ns and contain up to 102,000 gates. In the worldwide total ASIC market, Fujitsu ranked number one with a market share of 13.0 percent.

Compound Semiconductors

During fiscal 1991, the compound semiconductor market developed a strong demand for low-noise high electron mobility transistors (HEMTs) for satellite broadcasting receivers. Fujitsu developed and released a super HEMT that can capture very weak signals because of dramatic improvements in gain and signal-to-noise ratio. Fujitsu also developed and released a GaAs gate array that features high-speed, large-scale integration and low power consumption. To respond to future increases in demand for HEMTs, GaAs FETs, and GaAs ICs, Fujitsu constructed a plant targeted for GaAs products.

Other Electronic Devices

In fiscal 1991, in response to rising use in home electrical appliances, telephones, and office machines, Fujitsu added application specific microcontrollers to its market offerings. Fujitsu also developed a 16-bit microcontroller that performs full 16-bit processing with an instruction cycle of 100ns. In addition, significant releases included a 16-inch plasma display with a resolution of 1280 × 1024 pixels and a membrane keyboard with a small footprint and low profile.

Other Operations

Other operations range from products such as car stereos to automatic vehicle monitors. Although in fiscal 1991, this division accounted for only 4 percent of total net sales, it increased approximately 16 percent to $885.

Further Information

For further information pertaining to the company's business segments, please contact the appropriate Dataquest industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1987	1988	1989	1990	1991
Five-Year Revenue	11,218	14,830	18,616	17,839	21,043
Percent Change	46.71	32.19	25.53	(4.17)	17.96
Capital Expenditure	814	1,209	1,825	2,105	2,231
Percent of Revenue	7.25	8.16	9.81	11.80	10.60
R&D Expenditure	1,043	1,378	1,925	2,093	2,336
Percent of Revenue	9.30	9.29	10.34	11.73	11.10
Number of Employees	89,293	94,825	104,503	115,000	145,000
Revenue ($K)/Employee	126	156	178	155	145
Net Income	135	305	545	607	585
Percent Change	(23.00)	125.24	78.74	11.29	(3.55)
Exchange Rate (U.S.$1=¥)	159.51	138.02	128.25	142.93	141.21

1991 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

Source: Fujitsu Limited
Annual Reports
Dataquest (December 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1987	1988	1989	1990	1991
Japan	78.06	77.89	77.87	76.13	75.17
International	21.94	22.11	22.13	23.87	24.83

Source: Fujitsu Limited
Annual Reports
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1991 SALES OFFICE LOCATIONS

North America—3
Europe—4
Asia/Pacific—90
  Japan—82
ROW—3

MANUFACTURING LOCATIONS

North America

Fujitsu America
  Communications and information processing equipment, development of software
Fujitsu Business Communications Systems
  Communications equipment
Fujitsu Microelectronics
  Semiconductor devices
Intellistor Inc.
  Development of information processing equipment

Europe

Fujitsu Espana (Spain)
  Communications and information processing equipment
Fujitsu Microelectronics (Ireland)
  Semiconductor devices
Fujitsu Microelectronics (United Kingdom)
  Development of ASICs

Asia/Pacific

FKL-Dongwa (South Korea)
  Magnetic floppy disk drive heads
Fuji Electrochemical (Japan)
  Ferrites, electronic equipment, dry batteries
Fuji Facom (Japan)
  Development of computer systems for control
Fujitsu (Singapore)
  Electronic parts (digital switching systems)
Fujitsu Australia (Australia)
  Digital key telephones, digital PBXs
Fujitsu Automation (Japan)
  Automation equipment
Fujitsu Buhin (Japan)
  Electronic parts
Fujitsu Component (Malaysia)
  Electronic parts (relays, keyboards, connectors)
Fujitsu Computer Technology (Japan)
  Development of LSIs, software for information processing equipment
Fujitsu Denso (Japan)
  Communications/electronic equipment
Fujitsu General (Japan)
  Home electric appliances, communications equipment, data processing equipment
Fujitsu Isotec (Japan)
  Printers
Fujitsu Kasei (Japan)
  Plastic products for communications equipment
Fujitsu Kiden (Japan)
  Data processing equipment, indicators, molds
Fujitsu Microelectronics Asia (Singapore)
  Semiconductor devices
Fujitsu Microelectronics (Malaysia)
  Semiconductor devices
Fujitsu Miyagi Electronics (Japan)
  Semiconductor devices
Fujitsu Peripherals (Japan)
  Peripherals
Fujitsu TEN (Japan)
  Car radios, stereos
Fujitsu Thailand (Thailand)
  Magnetic disk drive heads, magnetic heads for printers
Fujitsu Tohoku Electronics (Japan)
  Semiconductor devices
Fujitsu VLSI (Japan)
  Development of semiconductor devices
Fujitsu Yamanashi Electronics (Japan)
  Semiconductor devices
Hasegawa Electric (Japan)
  Communications equipment
Kyushu Fujitsu Electronics (Japan)
  Semiconductor devices
Nihon Dengyon (Japan)
  Radio and digital communications equipment
PFU Ltd. (Japan)
  Microcomputers, peripherals
Shinano Fujitsu (Japan)
  Electronic parts
Shinko Electric Industries (Japan)
  Semiconductor parts
Takamisawa Electric (Japan)
  Switching systems, parts
Towa Electron (Japan)
  Capacitors, hybrid ICs
Yamagata Fujitsu (Japan)
  Magnetic disk drives

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SUBSIDIARIES

North America

Fujitsu America Inc. (United States)
Fujitsu Business Communications Systems Inc. (United States)
Fujitsu Canada Inc. (Canada)
Fujitsu Component of America Inc. (United States)
Fujitsu Computer Packaging Technologies Inc. (United States)
Fujitsu Computer Products of America Inc. (United States)
Fujitsu Customer Service of America Inc. (United States)
Fujitsu Imaging Systems of America Inc. (United States)
Fujitsu Microelectronics Inc. (United States)
Fujitsu Network Switching of America Inc. (United States)
Fujitsu Network Transmission Systems Inc. (United States)
Fujitsu Systems of America Inc. (United States)
Fujitsu Systems Business of America Inc. (United States)
Intellistor Inc. (United States)
Poqet Computer Corp. (United States)

Europe

Fujitsu Deutschland GmbH (Germany)
Fujitsu Espana S.A. (Spain)
Fujitsu Europe Ltd. (England)
Fujitsu Europe Telecom R&D Centre Limited (United Kingdom)
Fujitsu Finance (U.K.) plc (United Kingdom)
Fujitsu International Finance (Netherlands) B.V. (Netherlands)
Fujitsu Italia S.p.A. (Italy)
Fujitsu Microelectronics Ireland Ltd. (Ireland)
Fujitsu Microelectronics Italia S.r.l. (Italy)
Fujitsu Microelectronics Ltd. (England)
Fujitsu Mikroelektronik GmbH (Germany)
Fujitsu Nordic AB (Sweden)
Fulcrum Communications Limited (United Kingdom)

Asia/Pacific

Beijing Fujitsu Systems Ltd. (China)
Fuji Electrochemical Co. Ltd. (Japan)
Fujitsu Advanced Printing and Publishing Co. Ltd. (Japan)
Fujitsu Aichi Engineering Limited (Japan)
Fujitsu Australia Ltd. (Australia)
Fujitsu Australia Software Technology Pty. Ltd. (Australia)
Fujitsu Australia Wholesale Pty. Ltd. (Australia)
Fujitsu Automation Limited (Japan)
Fujitsu Basic Software Corporation (Japan)
Fujitsu Business Systems (Japan) Ltd. (Japan)
Fujitsu Communications Systems (Japan)
Fujitsu Component (Malaysia) Sdn. Bhd. (Malaysia)
Fujitsu Computer Technologies (Japan)
Fujitsu Dai-ichi Communication Software Limited (Japan)
Fujitsu Dai-ichi System Engineering Limited (Japan)
Fujitsu Denso Ltd. (Japan)
Fujitsu Devices Inc. (Japan)
Fujitsu Digital Technology Limited (Japan)
Fujitsu Distribution Systems Engineering Limited (Japan)
Fujitsu Documents Service Limited (Japan)
Fujitsu Electronics (Singapore) Pte. Ltd. (Singapore)
Fujitsu FACOM Information Processing Corporation (Japan)
Fujitsu Financial Information Systems Limited (Japan)
Fujitsu Fudosan Ltd. (Japan)
Fujitsu Hong Kong Ltd. (Hong Kong)
Fujitsu Isotec Limited (Japan)
Fujitsu Kansai Communication Systems Limited (Japan)
Fujitsu Kansai System Engineering Limited (Japan)
Fujitsu Kasei Ltd. (Japan)
Fujitsu Keihin Systems Engineering Limited (Japan)
Fujitsu Kiden Ltd. (Japan)
Fujitsu Korea Ltd. (Korea)
Fujitsu Kosan Limited (Japan)
Fujitsu Kyushu Communication Systems Limited (Japan)
Fujitsu Kyushu Systems Engineering Ltd. (Japan)
Fujitsu Laboratories Ltd. (Japan)
Fujitsu Lease (Japan)
Fujitsu Logistics Limited (Japan)
Fujitsu Microelectronics Asia Pte. Ltd. (Singapore)
Fujitsu Microelectronics (Malaysia) Sdn. Bhd. (Malaysia)
Fujitsu Microelectronics Pacific Asia Ltd. (Hong Kong)
Fujitsu Minami-Kyushu Systems Engineering Limited (Japan)
Fujitsu Miyagi Electronics Ltd. (Japan)
Fujitsu Nagano Systems Engineering Limited (Japan)
Fujitsu Network Engineering Limited (Japan)
Fujitsu New Zealand Holdings Ltd. (New Zealand)
Fujitsu New Zealand Ltd. (New Zealand)
Fujitsu OA Limited (Japan)
Fujitsu Office Machines Limited (Japan)

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Fujitsu Oita Software Laboratories Limited (Japan)
Fujitsu Peripherals Limited (Japan)
Fujitsu Program Laboratories Limited (Japan)
Fujitsu Shikoku Infortec Limited (Japan)
Fujitsu Shizuoka Engineering Limited (Japan)
Fujitsu (Singapore) Pte. Ltd. (Singapore)
Fujitsu Sinter Limited (Japan)
Fujitsu Social Science Laboratory Limited (Japan)
Fujitsu Social Systems Engineering Limited (Japan)
Fujitsu Supplies Limited (Japan)
Fujitsu System Integration Laboratories Ltd. (Japan)
Fujitsu Systems Construction (Japan)
Fujitsu Systems Consulting (Japan)
Fujitsu Technosystems Limited (Japan)
Fujitsu TEN Limited (Japan)
Fujitsu (Thailand) Co. Ltd (Thailand)
Fujitsu Tohoku Electronics Ltd. (Japan)
Fujitsu Tohoku Systems Engineering Limited (Japan)
Fujitsu Tokia Systems Engineering Limited (Japan)
Fujitsu Trading Ltd. (Japan)
Fujitsu VLSI Limited (Japan)
Fujitsu Quantum Devices Ltd. (Japan)
Gunma Fujitsu Limited (Japan)
Hasegawa Electric Co. Ltd. (Japan)
Ishikawa Fujitsu Software Limited (Japan)
Iwaka Densi Ltd. (Japan)
Kyushu Fujitsu Electronics Ltd. (Japan)
Nihon Dengyo Limited (Japan)
Okinawa Fujitsu Systems Engineering Limited (Japan)
PFU Limited (Japan)
Shimane Fujitsu (Japan)
Shinano Fujitsu Ltd. (Japan)
Shin-Etsu Fujitsu (Japan)
Shinko Electric Industries Co. Ltd. (Japan)
Ten Onkyo Ltd. (Japan)
Totalizator Engineering Limited (Japan)
Toyama Fujitsu (Japan)
Yamagata Fujitsu Limited (Japan)
Yonago Fujitsu (Japan)

ROW

Fujitsu de Brasil Limitada (Brazil)
Fujitsu Vitonia Computadores e Servicos Ltda (Brazil)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

EPWING Consortium
The EPWING Consortium was created with Sony Corporation and several publishing houses to establish a standard for CD-ROM electronic books.

Hitachi Ltd., Sony Corporation, Texas Instruments Japan Ltd.
Fujitsu Ltd., Hitachi Ltd., Sony Corporation, and Texas Instruments Japan Ltd. signed an agreement to codevelop the MUSE decoder integrated circuits. MUSE is the standard high-definition television format in Japan. The cooperative efforts by the four companies is expected to accelerate the development of a small, low-cost, next generation MUSE decoder.

Texas Instruments
Fujitsu and Texas Instruments signed a five-year global semiconductor patent cross-licensing agreement. The deal encompasses most of the semiconductor patents by the two firms except the Texas Instruments Kilby patent.

Cadence Design Systems
Cadence Design Systems and Fujitsu have signed a joint development agreement to produce ASIC software tools.

Quotient plc
Quotient plc and Fujitsu signed a joint development agreement to produce financial software systems.

KBS2 Corp.
KBS2 Corp. and Fujitsu signed a joint development agreement to develop crashworthiness software.

Rodime plc
Rodime plc entered into a nonexclusive royalty-free patent cross-licensing agreement with Fujitsu Ltd. The agreement is for the use of Rodime patents that apply to 3.5-inch drives.

Cincom Systems
Cincom Systems and Fujitsu will combine business efforts in the Canadian market to offer high-performance software.

McDonnell Douglas Information Systems International (MDISI)
MDISI and Fujitsu have made an agreeement to port the PRO-IV 4GL software package developed by MDISI to Fujitsu's K Series office computers. The two firms will then market the software.

1990

Novell K.K.
A joint marketing venture to sell Netware products in Japan was formed with Novell and six partners, Fujitsu being one of them.

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Isuzu
The two companies have formed an automotive electronics venture and currently are attempting to get General Motors to join.

Matsushita Electric Industrial
The two companies plan to strengthen their business relationship by mutually supplying their computers on an OEM basis. Fujitsu will supply Matsushita with its high-end laptop and desktop 32-bit PCs; Matsushita will supply Fujitsu with the M550 and M600 series of 32-bit desktop personal computers.

Poqet Computer
Fujitsu will produce and market Poqet Computer's pocket-size computer under license. Fujitsu's stake in Poqet Computer has grown gradually over the last two years because of mutual agreement and investments into R&D and manufacture of Poqet's product lineup.

Nokia Data Systems Oy
An agreement has been made whereby Nokia will act as an OEM of digital PBX systems (the F-620 and F-640) for Fujitsu.

Matsushita Electric Industrial
The two companies plan to strengthen their business relationship by mutually supplying their computers on an OEM basis.

UNIX International
Fujitsu has joined a new marketing group comprising 21 other high-tech companies. The group will promote UNIX's System V release 4 and further standard developments.

Molecular Design Ltd. and IBM
Fujitsu has formed a relationship with the two companies to ensure that Molecular Design software for managing and communicating scientific information will run on their computers.

Mitsui Bank Research Institute
The two companies have agreed to establish a system consulting service.

MEDIAGENIC
MEDIAGENIC has agreed to develop entertainment software for the Fujitsu FM TOWNS.

Daisy/Cadnetix Inc.
The companies jointly produced an ASIC design kit developed for the DAZIX design environment on the Sun-4 family of workstations running on UNIX.

Vitesse Semiconductor Corporation
The companies have entered into an alternate source agreement with regard to Vitesse's Fury gallium arsenide (GaAs) VLSI gate-array family.

1989

Japan Tobacco Inc.
Fujitsu formed a tie-up agreement with Japan Tobacco whereby Fujitsu will market two of Japan Tobacco's software modules.

The Australian National University in Canberra
The two organizations signed an R&D agreement for two three-year projects. One project is to develop a small image processing system; the other is to develop software for parallel processors.

Vitesse Semiconductor
The two companies agreed to jointly develop GaAs gate arrays.

Southern New England Telecommunications Systems
Southern New England Telecommunications agreed to market Fujitsu's ISDN telecommunications equipment in the United States on an exclusive basis. The list of products includes digital telephones and terminal adapters.

NTT Data Communications Systems
The two companies will jointly market their respective logic chip design software products as a total CAE design system.

Sony Corporation
The two companies jointly developed a trial common rule to develop CD-ROM XA software for their personal computers.

Bell Atlantic Optical Network (SONET)
Fujitsu agreed to sell Bell Atlantic's transmission products under a two-year, $2 million contract. Fujitsu will provide its FLM 50/150 Fiber LOOP Multiplexer for deployment in Bell Atlantic areas.

Poqet Computer Corporate
An agreement provides Poqet with funding and credit guarantees; the companies made a cooperative technology agreement allowing for mutual adaptation of technologies and joint development of new technology.

Sun Microsystems Inc.
Sun and Fujitsu will jointly develop a high-speed RISC chip.

1988

Telecom Australia
Telecom Australia agreed to sell Fujitsu's digital PBXs in Australia; the companies established a sales joint-venture, Information Switching Technology.

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Daisy Systems
Fujitsu's FAME was made available on Daisy's Advansys Series of CAD/CAE systems.

Hitachi Ltd.
The two companies agreed to cooperate on the development of a 32-bit MPU and peripheral LSI family based on TRON architecture.

MERGERS AND ACQUISITIONS

Fulcrum Communications Ltd.
British Telecommunications plc sold the manufacturing division of Fulcrum Communications to Fujitsu Ltd. but will retain a 25.1 percent interest in the new company. The company makes and markets public switched telephone network equipment such as call monitoring and logging products, call queueing, exchange monitoring, and fiber-optic tools.

Nokia Data
Nokia Data, which is one of Europe's largest computer companies, was purchased by ICL Ltd. (80 percent owned by Fujitsu). ICL Ltd. will pay $402.3 million for the company and will assume about $174.9 million of Nokia's debt. Nokia's parent corporation, Nokia Corporation, will receive a 5 percent stake in ICL Ltd.

Poqet Computer Corporation
Fujitsu increased its stake to 85 percent in Poqet Computer Corporation for $37 million. In 1988, Fujitsu had purchased a 28 percent equity stake in the firm. Fujitsu has been working with Poqet Computer to develop Japanese versions of pocket computers.

Softway
Fujitsu acquired a 40 percent interest in Softway, an Australian software company. Both companies will collaborate on UNIX systems development. Continental Venture Capital, Softway, and Techway staff also hold a 20 percent interest in the company.

Hal Computer Systems Inc.
Fujitsu Ltd. acquired a 44 percent interest totaling $40.2 million in Hal Computer Systems. The company is developing a family of high-performance open systems based on the SPARC architecture and UNIX System V Release 4.

ICL plc
Fujitsu purchased 80 percent of ICL, a subsidiary of STC plc. The merger increases Fujitsu's global presence and makes it the second largest computer manufacturer in the world.

KEY OFFICERS

Takuma Yamamoto
Chairman and representative director

Matami Yasufuku
Vice chairman and representative director

Tadashi Sekizawa
President and representative director

Kazuo Watanabe
Vice president and representative director

Mikio Ohtsuki
Executive vice president

Motojiro Shiromizu
Executive director

Mamoru Mitsugi
Executive director

Tokio Tatsuta
Executive director

Eigo Kato
Executive director

Matsuro Umezu
Executive director

Ryoichi Sugioka
Executive director

PRINCIPAL INVESTORS

Fuji Electric Co. Ltd.—13.5 percent
Asahi Mutual Life Insurance Company—6.5 percent

FOUNDERS

Information is not available.

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Table 3
Balance Sheet
Fiscal Year Ending March 31
(Millions of U.S. Dollars)

Balance Sheet	1987	1988	1989	1990	1991
Cash	1,125	1,764	2,379	1,833	2,906
Receivables	2,904	3,645	4,615	5,104	6,025
Marketable Securities	137	648	189	225	159
Inventory	2,562	3,354	3,734	4,097	5,038
Other Current Assets	307	408	452	265	599
Total Current Assets	7,035	9,818	11,369	11,523	14,726
Net Property, Plants	3,424	4,289	5,481	5,777	6,947
Other Assets	2,067	2,678	3,617	3,489	4,792
Total Assets	12,527	16,784	20,467	20,789	26,465
Total Current Liabilities	4,991	7,059	8,581	8,979	11,939
Long-Term Debt	2,117	2,185	2,467	2,368	4,091
Other Liabilities	1,153	1,548	1,924	1,849	2,225
Total Liabilities	8,261	10,792	12,973	13,197	18,256
Converted Preferred Stock	NA	NA	NA	NA	NA
Common Stock	2,115	3,364	4,252	4,219	4,350
Other Equity	71	92	110	110	123
Retained Earnings	2,080	2,536	3,133	3,264	3,737
Total Shareholders' Equity	4,266	5,992	7,495	7,592	8,210
Total Liabilities and Shareholders' Equity	12,527	16,784	20,467	20,789	26,465
Exchange Rate (U.S.$1=¥)	159.51	138.02	128.25	142.93	141.21

NA = Not available

Source: Fujitsu Limited
Annual Reports
Dataquest (December 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending March 31
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	11,218	14,830	18,616	17,839	21,043
Domestic	8,757	11,551	14,496	13,581	15,818
Overseas	2,461	3,279	4,120	4,258	5,225
Cost of Sales	7,728	9,703	11,914	11,043	12,893
R&D Expense	1,043	1,378	1,925	2,093	2,336
SG&A Expense	2,057	2,883	3,328	3,337	4,298
Capital Expense	814	1,209	1,825	2,105	2,231
Pretax Income	301	768	1,210	1,191	1,088
Pretax Margin (%)	2.68	5.18	6.50	6.68	5.17
Net Income	135	305	545	607	585
Shares Outstanding, Millions	1,593.3	1,710.0	1,760.1	1,760.1	1,760.1
Per Share Data					
Earnings	13.40	23.50	36.80	36.80	$36.80
Dividend	8.00	8.00	9.00	9.00	9.00
Book Value	2.68	3.50	4.26	4.31	4.66
Exchange Rate (U.S.$1=¥)	159.51	138.02	128.25	142.93	141.21

Source: Fujitsu Limited
Annual Reports
Dataquest (December 1991)

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Table 5
Balance Sheet
Fiscal Year Ending March 31
(Millions of Yen)

Balance Sheet	1987	1988	1989	1990	1991
Cash	179,409	243,492	305,166	261,928	410,365
Receivables	463,150	503,035	591,815	729,471	850,761
Marketable Securities	21,863	89,402	24,219	32,154	22,413
Inventory	408,718	462,869	478,840	585,546	711,392
Other Current Assets	49,035	56,326	58,017	37,867	84,579
Total Current Assets	1,122,175	1,355,124	1,458,057	1,646,975	2,079,510
Net Property, Plants	546,233	591,921	702,988	825,757	980,961
Other Assets	329,779	369,549	463,882	498,633	676,699
Total Assets	1,998,187	2,316,594	2,624,927	2,971,365	3,737,170
Total Current Liabilities	796,143	974,268	1,100,577	1,283,409	1,685,950
Long-Term Debt	337,660	301,618	316,395	338,481	577,700
Other Liabilities	183,980	213,685	246,778	264,347	314,221
Total Liabilities	1,317,783	1,489,571	1,663,750	1,886,237	2,577,871
Converted Preferred Stock	NA	NA	NA	NA	NA
Common Stock	337,308	464,365	545,369	602,980	614,205
Other Equity	11,359	12,659	14,050	15,658	17,381
Retained Earnings	311,737	349,999	401,758	466,490	527,713
Total Shareholders' Equity	680,404	827,023	961,177	1,085,128	1,159,299
Total Liabilities and Shareholders' Equity	1,998,187	2,316,594	2,624,927	2,971,365	3,737,170
Exchange Rate (U.S.$1=¥)	159.51	138.02	128.25	142.93	141.21

NA = Not available

Source: Fujitsu Limited
Annual Reports
Dataquest (December 1991)

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Table 6
Consolidated Income Statement
Fiscal Year Ending March 31
(Millions of Yen, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	1,789,417	2,046,802	2,387,442	2,549,773	2,971,462
Domestic	1,396,876	1,594,193	1,859,129	1,941,075	2,233,493
Overseas	392,541	452,609	528,313	608,698	737,969
Cost of Sales	1,232,722	1,339,183	1,527,908	1,578,343	1,820,554
R&D Expense	166,342	190,130	246,906	299,107	329,823
SG&A Expense	328,184	397,968	426,779	476,979	606,890
Capital Expense	129,822	166,924	234,113	300,822	315,109
Pretax Income	48,012	106,048	155,152	170,216	153,573
Pretax Margin (%)	2.68	5.18	6.50	6.68	5.17
Net Income	21,609	42,115	69,948	86,758	82,673
Shares Outstanding, Millions	1,593.3	1,710.0	1,760.1	1,802.4	1,812.1
Per Share Data					
Earnings	13.40	23.50	36.80	45.40	42.20
Dividend	8.00	8.00	9.00	9.00	10.00
Book Value	427.04	483.64	546.09	602.05	639.75
Exchange Rate (U.S.$1=¥)	159.51	138.02	128.25	142.93	141.21

Source: Fujitsu Limited
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Table 7
Key Financial Ratios
Fiscal Year Ending March 31

Key Financial Ratios	1987	1988	1989	1990	1991
Liquidity					
Current (Times)	1.41	1.39	1.32	1.28	1.23
Total Assets/Equity (%)	293.68	280.11	273.10	273.83	322.36
Current Liabilities/Equity (%)	117.01	117.80	114.50	118.27	145.43
Total Liabilities/Equity (%)	193.68	180.11	173.10	173.83	222.36
Profitability (%)					
Return on Assets	1.08	1.82	2.66	2.92	2.21
Return on Equity	3.40	6.19	8.46	9.03	7.62
Profit Margin	1.21	2.06	2.93	3.40	2.78
Other Key Ratios					
R&D Spending % of Revenue	9.30	9.29	10.34	11.73	11.10
Capital Spending % of Revenue	7.25	8.16	9.81	11.80	10.60
Employees	89,293	94,825	104,503	115,000	145,000
Revenue (¥)/Employee	20,040	21,585	22,846	22,172	20,493
Capital Spending % of Assets	6.50	7.21	8.92	10.12	8.43
Exchange Rate (U.S.$1=¥)	159.51	138.02	128.25	142.93	141.21

Source: Fujitsu Limited
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GM Hughes Electronics Corporation

3044 West Grand Boulevard
Detroit, Michigan 48202
Telephone: (313) 556-3510
Fax: (313) 974-4487
Dun's Number: 00-535-6613

Date Founded: 1985

CORPORATE STRATEGIC DIRECTION

GM Hughes Electronics Corporation (GMHE) has been a consistent world leader in the areas of automotive, defense, and space electronics since its inception in 1985. The company was formed in 1985 when General Motors bought Hughes Aircraft Company for $2.7 billion*, changed the name to GM Hughes Electronics, and made GMHE a wholly owned subsidiary of General Motors. GMHE operates through two main subsidiaries—Hughes Aircraft Company and Delco Electronics Corporation.

Hughes Aircraft Company's main customer has traditionally been the U.S. government because the majority of Hughes' revenue comes from the defense electronics industry. Hughes' recent strategy has been to expand into commercial electronics markets, freeing the company from complete reliance on governmental defense spending. In 1990, commercial sales rose to 25 percent of total revenue, up from 20 percent in 1989. The company's goal is to reach a 60 percent defense and 40 percent commercial mix by the mid-1990s and a 50 percent/50 percent mix by the end of the decade.

Delco Electronics has been among the world leaders in the automotive electronics industry throughout the 1980s and early 1990s. The company produces electronic systems for automobiles with applications including the PASS-Key theft deterrent system, the control system for GM's Supplemental Inflatable Restraint air bag safety system, and the electronic controller for antilock braking systems. Although Delco's primary customer remains GM North America, an increasing amount of sales are to international and non-GM automotive companies. International and non-GM sales reached a record-high $382 million in 1990, accounting for 10.2 percent of total revenue.

In 1990, Delco Electronics and Hughes continued to increase the number of joint ventures between the two companies. Hughes is currently involved in over 150 technology transfer projects that bring Hughes' aerospace technologies to the automotive electronics markets. The joint ventures between Delco and Hughes include GM's IMPACT Electric Vehicle, for which Hughes is working on battery development and Delco is producing the electronic components and HE Microwave Corporation, which is developing transmit/receive radar modules that can be used as obstacle detection systems in both aircraft and automobiles.

GM-Hughes Electronics' total revenue increased 3.2 percent to $11.7 billion in fiscal 1990 from $11.4 billion in fiscal 1989. Net income decreased 8.7 percent to $577.2 million in fiscal 1990 from $632.4 million in fiscal 1989. GMHE employed 96,000 people worldwide at the end of fiscal 1990.

Research and development expenditure totaled $568 million in fiscal 1990, representing 4.8 percent of total revenue. Capital expenditure increased 36.2 percent to $884 million in 1990, accounting for 7.5 percent of total revenue.

More detailed information is available in Tables 1 and 2, which appear after Business Segment Strategic Direction and present corporate highlights and revenue by region. Tables 3 through 5 at the end of this backgrounder present comprehensive financial information.

*All dollar amounts are in U.S. dollars.

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BUSINESS SEGMENT STRATEGIC DIRECTION

Hughes Aircraft Company

In fiscal 1990, Hughes Aircraft revenue totaled $7.82 billion, up 5.1 percent from $7.44 billion in fiscal 1989. New orders totaled $7.4 billion, down 14.9 percent from $8.7 billion in 1989. Hughes Aircraft employed 67,000 people at the end of fiscal 1990, down from the 1986 peak of 82,000 employees.

In response to the continuing reductions in defense spending over the last five years, Hughes has begun to broaden its business base to nonmilitary areas while still serving the military market. This new strategy includes being more selective when bidding on development contracts that require front-end investment to ensure that the probable long-term financial return is adequate. It also includes increasing international business by upgrading existing systems and codeveloping or coproducing new systems with international partners and expanding Hughes' business in such commercial areas as telecommunications, simulation, and training.

The defense industry will remain an important part of Hughes' focus, and as a result of the favorable performance of high technology weapon systems in the Persian Gulf War, Hughes anticipates that future defense programs will rely increasingly on high-technology systems such as those that Hughes offers. More than 50 Hughes systems were used by coalition forces in the Persian Gulf, including tactical missiles, night vision equipment, command and control systems, airborne and artillery-locating radar, and sensing devices.

Hughes is organized into seven operating groups, six of which are engaged in prime contract businesses. These six groups are: Electro-Optical and Data Systems, Ground Systems, Missiles Systems, Radar Systems, Space and Communications, and Training and Support Systems. The seventh group, Industrial Electronics, supplies high-technology components to the company's systems group and also markets its products externally.

The Electro-Optical and Data Systems Group designs and manufactures electro-optical sensors, weapon control systems, and information-processing systems for space, aircraft, and surface applications. Major awards during 1990 included a contract to produce tube-launched, optically tracked, wire-guided, (TOW) weapon subsystems for the U.S. Army's Bradley Fighting Vehicle, a contract to develop and produce a lightweight thermal weapon sight for army use, and a contract to fabricate a sensor for the Strategic Defense Initiative.

The Ground Systems Group develops and produces systems for automated airspace management, shipboard command and control, electronic warfare, weapons control displays, air traffic control workstations, jam-resistant communications, sonar, underwater weapons, and land- and ship-based radar applications. In 1990, the group captured a major order for its TracView PC-based air traffic control system from Germany. The order involves the supply and installation of 36 systems, most of which are to be installed in former East German sites near Berlin. The group also received contracts totaling over $180 million to build air defense systems for Iceland and the Republic of China.

The Missile Systems Group designs, develops, and manufactures tactical guided missiles, guidance and control systems, and launchers and is a major contributor to strategic defense technology. Major 1990 contracts included a $202 million Phoenix air-to-air missile contract from the U.S. Navy and a $194 million Maverick air-to-surface missile contract providing missiles to the U.S. Air Force and Navy as well as to Spain, Denmark, New Zealand, Iceland, and Germany.

The Radar Systems Group designs and produces airborne radar systems for advanced tactical, strategic, and reconnaissance aircraft and airborne avionics systems; airborne electronic warfare systems; data links; displays and controls; and automotive displays. The group reached a milestone in 1990 with the production of the 1000th radar system for the F/A-18 Hornet strike fighter, currently used by the United States, Canada, Australia, and Spain.

The Space and Communications Group produces spacecraft for national defense, communications, weather observation, and scientific space exploration. It also provides large-scale information-processing systems and services, and operates and sells satellite communications services and terrestrial private business networks. Advances in 1990 included orders for

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15 new satellites from customers such as the U.S. Navy, the Societe Europeenne des Satellites of Luxemborg, the Astra broadcast service in Western Europe, the American Mobile Satellite consortium, and the Telesat Mobile Company of Canada. New products included InTELEconference, a video conferincing system using VSATs; the Personal Earth Station 6000, a state-of-the-art VSAT; and the new HS 601 space satellite system.

The Training and Support Systems Group designs and develops advanced simulation, visual, and display systems for a variety of commercial and military requirements. The organization also designs and fabricates various automatic test systems and provides integrated logistic support for aerospace products worldwide. The 1988 acquisition of Rediffusion Simulation Corp began to pay benefits in 1990 as Hughes launched its Concept 90 flight simulators into the civil aviation flight training market. The company estimates that the initial sales of the Concept 90 simulator captured approximately 75 percent of the worldwide market for the systems, with new customers including Delta Airlines.

The Industrial Electronics Group develops, produces, and markets high-technology components, subsystems, and equipment with a variety of industrial, defense, commercial, and scientific applications. 1990 achievments included the introduction of a large-screen projection system for high-definition television (HDTV) based on innovative video-rate liquid crystal light valve technology and the production of the first 50,000 of 350,000 solar cells for the primary power system of the U.S. space station Freedom.

In addition to Hughes' seven operating groups, the company has three major organizations that provide research and development innovations and the unique products and technology required by the major systems groups. The three laboratories are the Hughes Research Laboratories, the Santa Barbara Research Center, and the Hughes Microelectronics Center.

Delco Electronics Corporation

In fiscal 1990, Delco Electronics' total revenue was $4.0 billion, up from $3.9 billion in fiscal 1989. Delco Electronics consists of seven strategic business units: Audio Systems, Body and Chassis Electronics, Delco Systems Operations, IC Delco, Instrumentation and Air Controls, International, and Powertrain Electronics.

The Audio Systems business unit supplies the automotive industry with entertainment, communication and information products such as radios, speakers, antennas, steering wheel controls, and cellular phones. New releases in 1990 included a speed-compensated volume control for car stereos and a compact disc changer for the van upfitter market.

The Body and Chassis Electronics unit produces electronic controls for vehicle body and chassis systems, such as air bag, theft deterrent, antilock brake, suspension, and steering control modules.

Delco Systems Operations designs and manufactures internal navigation and guidance systems and computers, avionics systems, fire control electronics, and computer systems for both military and commercial customers. This unit is divided into six business segments: Commercial Avionics Systems, Armament Systems, Space Booster Systems, Military Avionics Systems, Tactical Missile Subsystems, and Automotive Programs.

The IC Delco unit is Delco Electronics' in-house custom IC designer and manufacturer and operates as an internal, standalone business. According to Delco, the company is the largest automotive consumer of integrated circuits, producing 170 million ICs annually.

The Instrumentation and Air Controls unit supplies automotive, heating, ventilation, and air conditioning controls and related products. This division produced a major technological innovation in 1990 with the release of a head-up display for automobiles. This system, which is a derivative of fighter aircraft systems, projects speed and other important information into the driver's forward field of vision, reducing the need for the driver to avert his attention from the road.

The International business unit markets Delco Electronics products outside traditional North American units. International sales have doubled in the 1985-1990 time period, with new customers including Fiat, Renault, Toyota, and Volga Automotive Works (VAZ). New overseas centers have recently been opened in Singapore, Germany, and France.

The Powertrain Electronics unit designs and manufactures pressure sensors, electronic modules for engine and transmission controls, and electronic controls for ignition and voltage regulators for passenger cars and trucks.

Further Information

For more information about the company's business segments, please contact the appropriate industry service. Dataquest tracks GM Hughes Electronics through its Military Aerospace Technology Market industry service group.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	10,440.0	10,481.0	11,243.6	11,359.0	11,723.1
Percent Change	9.85	0.39	7.28	1.03	3.21
Capital Expenditure	700.6	469.4	533.0	648.5	884.3
Percent of Revenue	6.71	4.48	4.74	5.71	7.54
R&D Expenditure	408.1	416.0	550.9	592.0	567.6
Percent of Revenue	3.91	3.97	4.90	5.21	4.84
Number of Employees	102,000	100,000	100,000	94,000	96,000
Revenue (K)/Employee	102.35	104.81	112.44	120.84	122.12
Net Income	445.1	521.1	653.3	632.4	577.2
Percent Change	30.99	17.07	25.37	(3.20)	(8.73)

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	2,859.4	2,992.1	2,934.5	2,937.1
Quarterly Profit	145.6	152.3	120.9	158.4

Source: GM Hughes
Annual Reports and Forms 10-K
Dataquest (October 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
North America	89.34	88.38	87.65	86.53	83.84
International	10.66	11.62	12.35	13.47	16.16

Source: GM Hughes
Annual Reports and Forms 10-K
Dataquest (October 1991)

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1990 SALES OFFICE LOCATIONS

Hughes Aircraft Company

North America—12
Europe—10
Japan—1
Asia/Pacific—4
ROW—2

Delco Electronics Corporation

North America—3
Europe—4
Japan—1
Asia/Pacific—4

MANUFACTURING LOCATIONS

Hughes Aircraft Company

Missiles Systems Group: Canoga Park, California; Tucson, Arizona; La Grange, Georgia

This group specializes in the development and production of advanced tactical guided missile systems. Associated fields of interest include missile guidance and propulsion systems, missile launch equipment, and ancillary subsystems and components; production of the Phoenix (AIM-54C) long air-to-air missile; and production of the TOW heavy antitank missile. The Missile Systems Group also has a contract to develop a wireless version. The group also produces the Maverick (AGM-65DF/F/G) air-to-ground missile for the air force and Marine Corps with Raytheon as the second source and the AMRAAM (AIM-120A) Advanced Medium-Range Air-to-Air Missile, which replaces the Sparrow (AIM-7) with Raytheon again as the second source. The AMRAAM program also includes defense systems, land combat systems, missile development, naval systems, and strike systems; production of the Angle Rate Bombing Set (ARBS) for improving day and night bombing accuracy for the A-4M Skyhawk and AV-8B Harrier; production of the IR guidance section for the air force's GBU-15 air-to-surface glide weapon; and validation/demonstration of the Advanced Anti-Tank Weapon System Medium (AAWSM).

Radar Systems Group: El Segundo, California

This group is engaged principally in the development and production of aerospace radars, radar-based avionics systems, synthetic aperture radars, airborne weapon control systems, aerospace displays and controls, aerovehicle dedicated data links, airborne electronic countermeasures/countermeasures equipment, and airborne computers. It also is involved in the production of aircraft and missile instrumentation and airborne and underwater telemetry equipment; the F-14 program, the F-15 program, the F/A-18 program, and product operations; production of the APG-65 radar used on the F/A-18 Hornet and selected for the upgrade on the German F-4F Phantom; production of the APG-70 radar, replacing the APG-63, which will be installed in the F-15s and dual-role F-15Es; production of the APG-71 radar for the F-144D Super Tomcat, whose predecessor was the AWG-9 System; development and production of the AXQ-14 Data Link, a two-way communications system providing an extended weapon control capability for the GBU-15 guided weapon; production of the Advanced Synthetic Aperture Radar System (ASAR-2) for the air force TR-1, which provides real-time, high-resolution ground maps; development and production of Head Up Display (HUD) for Sweden's JAS-39 Gripen fighter-attack-reconaissance aircraft; development of laser radar, teamed with General Dynamics, for the Cruise Missile Advanced Guidance Demonstration Program; development of the Airborne Shared Aperture Program to integrate radar, electronic countermeasures, and electronic support measures into one system; and modification of the AWG-9 weapons control system on the F-14.

Space and Communications Group: El Segundo, California

This group specializes in the development and production of earth satellites for telecommunications, earth observation, and meteorology; and payloads for space exploration. Additional responsibilities include deep-space communications equipment. Supporting capabilities include sophisticated antenna systems design; hydraulic, mechanical and thrust-generating components for space station keeping and altitude control; space-qualified microwave and electronics components; and space environmental test facilities. Other activities include development and production of commercial systems, defense information systems, government electronic systems, product operations, and systems applications; new work with INTELSAT; development of a space battery; preliminary design

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for the National Test Bed; and production of Ireland and Japan's first commercial communications satellite systems.

Ground Systems Group: Fullerton, California

This group develops and produces automated command-and-control and tactical air defense environment systems, civilian air traffic control systems, communications systems and equipment, radar systems, electronic warfare systems, sonar systems and sonar-guided torpedos, data processing and display systems, land mine warfare systems, command-and-control systems, quality systems, operations systems, software engineering, and training systems. It also is involved in the development and production of the UYQ-21 navy tactical display system, an automated air traffic control system for Korea, and air defense radars for Norway. It has a development contract for replacement of the U.S. air traffic control system and is involved in the production and development of weapon control display systems for the navy, the army's Enhanced Position Location Reporting System (EPLRS), a sonar based on low-frequency acoustic sensors, TPQ-36 radar, TPQ-37(V)4 radar, Surveillance Towed Assay Sonar Systems, electronics for a battlefield mine, and SLQ-17A Naval Electronic Warfare system.

Electro-Optical and Data Systems Group: El Segundo, California

This group is engaged principally in the development and production of electro-optical sensors and fire control systems for use in space, airborne, and surface applications; tactical and high-energy laser systems; and aerospace computers, signal and data processors, and software systems. Additional responsibilities include design and manufacturing of components, materials, and processes, advanced tactical programs, product operations, software engineering, space and strategic systems, tactical engineering, tactical programs, and technology support. Additional development and production include guidance electronic assemblies for the Trident II, thermal imaging and laser range finders for the M-1 tank, a thermal imaging system for the F/A-18 Hornet, a turret-mounted night vision system for U.S. customs, day-night vision sights for the TOW missile, a Marine Corps laser target-pinpointing device, an advanced carbon dioxide laser radar, a small-package advanced computer, the IMPRINT beyond visual range aircraft identification, laser range finders, the Sea Lite Beam Director (SLBD), a thermal imaging system for the army's Cobra helicopter, and the TOW weapon subsystem for the army's Bradley Fighting Vehicle.

Training and Support Systems: Long Beach, California

This group designs and fabricates test equipment and training and engineering simulators. It provides integrated logistic support of aerospace products, including field engineering, field installation and modification, repairs, provisions, and training and technical publications. It also performs range systems engineering, site activation and operation, field service and support, and support program development and develops test and training systems. Additional development and production includes the weapons tactics trainer for the F/A-18 Hornet, a simulator for the Advanced Tactical Fighter (ATF), the REALSCENE high-resolution, real-time visual and sensor system, Weapon Systems Test Sets for the Marine Corps, and TOW testing for the Bradley Fighting Vehicle.

Hughes Research Laboratories: Malibu, California

This group engages in long-range applied research, principally in physics and electronics. Major areas of research include solid-state microwave devices and circuits; submicron microelectronics, VLSI techniques, and gallium arsenide (GaAs) integrated circuits; ion beam technology, including ion propulsion systems; lasers and electro-optical components; fiber and integrated optics; materials for infrared sensors; pattern recognition and artificial intelligence systems; display devices; and new electronic materials. The group also is engaged in chemical physics, exploratory studies, ion physics, optical circuits, optical physics, plasma physics, and silicon integrated circuits.

Santa Barbara Research Center: Goleta, California

This group is engaged in advanced infrared technology, electro-optical technology, and fire sensing and suppression systems.

Industrial Electronics Group: Torrance, California

This group develops and produces advanced systems components and equipment used in a variety of

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scientific, industrial, military, and commercial applications. Broad areas of interest include microwave and millimeter-wave instruments, devices, components, and systems; image sensing; storage and display devices; industrial and commercial lasers; production and automation equipment, multiplex wire and secure voice communication systems; hybrid microcircuits; connectors and cable assemblies; solar cells; high-power, high-frequency traveling wave tubes; memory modules for high-speed computers; microwave integrated circuits for phase-array radars using GaAs; and high-power hybrid microcircuits.

Hughes Microelectronics Center: Carlsbad, California; Newport, California

This center develops and produces custom and semicustom monolithic integrated circuits, including gate arrays, very high-speed integrated circuit (VHSIC) class and other VLSI devices, and infrared focal plane components.

Other Industrial Electronics Group Facilities:

Irvine, California—This site has two facilities, one to develop and manufacture connecting devices and one to develop and manufacture microelectronic systems.
Carlsbad, California—This site develops and produces industrial products.
Newport Beach, California—This site develops and produces microelectronic circuits.

MANUFACTURING LOCATIONS

Delco Electronics Corporation

Kokomo, Indiana

The Delco Systems Operating Group (DSO) produces computers, guidance, navigation, and avionics systems for commercial and military air and space vehicles, as well as armament systems for armored vehicles.

SUBSIDIARIES

North America

Advanced Electronics Systems International (United States)
Delco Electronics Corporation (United States)
Delco Electronics Overseas Corp. (United States)
Delco Electronics Service Corp. (United States)
ESAL Company (United States)
Hughes Advanced Systems Company (United States)
Hughes-Aircraft Alabama (United States)
Hughes Aircraft Co. Inc. (United States)
Hughes Aircraft Company (United States)
Hughes Aircraft Holdings Canada Inc. (Canada)
Hughes Aircraft International Services Co. (United States)
Hughes Aircraft Mississippi Inc. (United States)
Hughes Aircraft South Carolina (United States)
Hughes Aircraft Systems Canada Ltd. (Canada)
Hughes Aircraft Systems International (United States)
Hughes Communications Inc. (United States)
Hughes Foreign Sales Corp. (U.S. Virgin Islands)
Hughes Georgia Inc. (United States)
Hughes International Inc. (United States)
Hughes International Sales Corp. (United States)
Hughes Investment Management Co. (United States)
Hughes Missiles Electronics (United States)
Hughes Nadge Corp. (United States)
Hughes Network Systems Inc. (United States)
Hughes Optical Products Inc. (United States)
Hughes Simulation Systems Inc. (United States)
Hughes Systems International (United States)
Hughes Technical Services Co. (United States)
Hughes Training Systems Inc. (United States)
International Electronics Systems (United States)
L-T Ranches Inc. (United States)
MDP Ltd. (United States)
Rediffusion Commercial Simulation Inc. (United States)
Rediffusion Simulation (Canada) Inc. (Canada)
Rediffusion Simulation Inc. (United States)
Santa Barbara Research Center (United States)
Spectrolab Inc. (United States)
Systems Building Corp. (United States)

Europe

Atlantic Satellites Ltd. (Ireland)
DCC Ltd. (United Kingdom)
Hughes Information Systems (Netherlands)
Hughes (U.K.) Ltd. (England)
Husint S.A. (Switzerland)

ROW

Delnos S.A. de S.V. (Mexico)
GM Singapore Pte. Ltd. (Singapore)

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ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

General Motors Corporation
General Motors and GM Hughes Electronic signed an agreement to sell and service cellular phones through GM dealers and sell cellular network equipment through Hughes Aircraft Co.

1989

Perkin-Elmer
Hughes Aircraft and the Perkin-Elmer Corporation signed an agreement whereby Hughes is to purchase Perkin-Elmer's Electro-Optics Technology Division (EOTD), a leading provider of electro-optical systems for specialized scientific and military applications.

1987

Tektronix
Delco Electronics Corporation and Tektronix's Liquid Crystal Shutter Strategic Program Unit (LCS SPU) entered into a joint technology development agreement. The technology partnership gives Delco Electronics the exclusive license to use Tektronix LCS SPU's liquid crystal shutter display technology in automotive instrument panels.

MERGERS AND ACQUISITIONS

1989

Sytek Inc.
Hughes Aircraft acquired Sytek from General Instrument Corporation.

Western Union Corporation
Hughes Aircraft acquired Western Union's Westar communications satellite system. The agreement was subject to approval of the Federal Communications Commission, which was granted in November 1989. Westar includes three satellites in orbit and one yet to be launched. Hughes already operates three satellites as the Galaxy system, which primarily services cable TV and radio.

1988

Honeywell
Hughes Aircraft acquired Honeywell's Training and Control Systems Division, one of the country's leading providers of electronic-simulation-based military training systems.

KEY OFFICERS

GM Hughes Electronics Corporation

Robert J. Schultz
Chairman, president, and chief executive officer

Donald J. Almquist
Executive vice president and director

Malcolm W. Currie
Executive vice president and director

Hughes Aircraft Company

Malcom R. Currie
Chairman and chief executive officer

D. Kenneth Richardson
President, chief operating officer, and director

James A. Abrahamson
Executive vice president and director

Michael T. Smith
Executive vice president, chief financial officer and director

Delco Electronics Corporation

Donald J. Almquist
Chairman, president, and chief executive officer

Harry G. Olsen
Vice president, chief financial officer, and director

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Table 3
Balance Sheet
Fiscal Year Ending in December
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash	260.5	731.3	698.3	652.4	4,734.3
Receivables	779.4	908.2	903.6	937.7	452.9
Marketable Securities	-	-	7.5	3.6	966.0
Inventory	633.8	664.0	783.9	795.4	6.4
Other Current Assets	1,654.7	1,822.8	2,133.1	2,144.5	862.5
Total Current Assets	3,328.4	4,126.3	4,526.4	4,533.6	2,446.5
Net Property, Plants	2,767.2	2,750.6	2,805.0	2,991.8	3,353.7
Other Assets	4,286.3	4,249.7	4,476.4	4,674.7	4,639.5
Total Assets	10,381.9	11,126.6	11,807.8	12,200.1	12,727.5
Total Current Liabilities	2,946.2	3,427.3	3,424.3	3,197.3	3,360.4
Long-Term Debt	353.0	168.4	285.1	270.5	271.9
Other Liabilities	393.0	459.5	548.4	834.1	996.9
Total Liabilities	3,692.2	4,055.2	4,257.8	4,301.9	4,629.2
Total Shareholders' Equity	6,689.7	7,071.4	7,550.0	7,898.2	8,098.3
Converted Preferred Stock	-	-	-	-	-
Common Stock	6,365.9	6,365.9	6,365.9	6,365.9	6,365.9
Other Equity	-	3.3	3.6	7.4	(81.9)
Retained Earnings	323.8	702.2	1,180.5	1,524.9	1,814.3
Total Liabilities and Shareholders' Equity	10,381.9	11,126.6	11,807.8	12,200.1	12,727.5

Source: GM Hughes
Annual Reports and Forms 10-K
Dataquest (October 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	10,440.0	10,481.0	11,243.6	11,359.0	11,723.1
U.S. Revenue	9,327.2	9,263.3	9,855.4	9,828.6	9,828.5
Non-U.S. Revenue	1,112.8	1,217.7	1,388.2	1,530.4	1,894.6
Cost of Sales	8,154.8	8,035.5	8,446.1	8,521.3	8,791.1
R&D Expense	408.1	416.0	550.9	592.3	567.3
SG&A Expense	851.5	882.9	1,094.4	1,112.3	1,176.6
Capital Expense	700.6	469.4	533.0	648.5	884.3
Pretax Income	811.2	899.2	983.9	987.7	1,038.4
Pretax Margin (%)	7.77	8.58	8.75	8.70	8.86
Effective Tax Rate (%)	45.10	42.00	35.50	36.00	44.40
Net Income	445.1	521.1	653.3	632.4	577.2
Shares Outstanding, Millions	127.8	130.8	127.9	95.7	88.1
Per Share Data					
Earnings	1.48	1.67	2.01	1.94	1.82
Dividend	-	-	-	-	-
Book Value	52.35	54.06	59.03	82.53	91.92

Source: GM Hughes Corporation
Annual Reports and Forms 10-K
Dataquest (October 1991)

Table 5
Key Financial Ratios
Fiscal Year Ending in December

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	1.13	1.20	1.32	1.42	1.41
Total Assets/Equity (%)	155.19	157.35	156.39	157.47	157.16
Current Liabilities/Equity (%)	44.04	48.47	45.35	40.48	41.50
Total Liabilities/Equity (%)	55.19	57.35	56.39	54.47	57.16
Profitability (%)					
Return on Assets	4.29	4.68	5.53	5.18	4.54
Return on Equity	6.65	7.37	8.65	8.01	7.13
Profit Margin	4.26	4.97	5.81	5.57	4.92
Other Key Ratios					
R&D Spending % of Revenue	3.91	3.97	4.90	5.21	4.84
Capital Spending % of Revenue	6.71	4.48	4.74	5.71	7.54
Employees	102,000	100,000	100,000	94,000	96,000
Revenue ($K)/Employee	102.35	104.81	112.44	120.84	122.12
Capital Spending % of Assets	6.75	4.22	4.51	5.32	6.95

Source: GM Hughes
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Hewlett-Packard Company

3000 Hanover Street
Palo Alto, California 94303
Telephone: (415) 857-1501
Fax: (415) 857-5518
Dun's Number: Not available

Date Founded: January 1, 1939

CORPORATE STRATEGIC DIRECTION

Hewlett-Packard Company (HP) is engaged worldwide in the design, manufacture, and servicing of a broad array of precision electronic instruments and systems for measurement, analysis, and computation. HP offers integrated systems solutions to specific customer problems. Founded in 1939 by Bill Hewlett and Dave Packard, HP employs 92,000 people worldwide and had revenue of $13.2 billion* during 1990.

The $13.2 billion revenue in fiscal 1990 represented an increase of 11.2 percent over 1989's total revenue of $11.9 billion. Net income decreased 10.9 percent to $739 million in fiscal 1990, down from a 1989 record net income of $829 million. A large factor in this decrease in net income deals was the increasing proportion of HP's sales to volume purchasers such as dealers and OEMs, who receive discounts on the HP products they purchase. These discounts reduce earnings by driving up HP's cost of selling its products.

Domestic sales totaled $6.0 billion, $5.6 billion, and $4.8 billion, respectively, during fiscal years 1990, 1989, and 1988. International sales reached $7.2 billion, $6.3 billion, and $5.1 billion in fiscal years 1990, 1989, and 1988, representing 54.5, 53.3, and 51.6 percent of total revenue, respectively. The majority of international orders were from the commercial sector, primarily in Europe. The percentage of total respective international revenue derived from Europe during fiscal years 1990, 1989, and 1988 was 66.1, 65.2, and 65.2 percent.

In October 1990, HP began to implement a major reorganization in its management structure to reduce operating expenses and facilitate the management of research and development, manufacturing, and marketing activities. Three new organizations were formed as a result of the reorganization: the Computer Systems Organization, the Computer Products Organization, and the Test and Measurement Organization.

The reorganization aligned businesses that had traditionally operated separately in HP's structure, but had been converging in form and function in recent years. The Computer Systems Organization unites HP's workstation and multiuser systems businesses, the Computer Products Organization combines the company's PCs and peripherals businesses, and the Test and Measurement Organization combines the activities of the company's Electronic Instruments and Microwave and Communications groups.

Although HP's structure has been recently reorganized, the company continues to financially divide operations into six business segments, all of which are engaged in the design and manufacture of precision electronic equipment for measurement, analysis, and computation. The six business segments are Measurement, Design, Information, and Manufacturing Equipment and Systems; Peripherals and Network Products; Service for Equipment, Systems, and Peripherals; Medical Electronic Equipment and Service; Analytical Instrumentation and Service; and Electronic Components. The Measurement segment continued to be the largest source of income in fiscal 1990 for the company, with $5 billion in revenue, or 36.9 percent of total revenue. The Service for Equipment, Systems, and Peripherals segment showed the highest rate of increase in 1990, increasing 21.3 percent to $2.6 billion.

HP has more than 480 sales and service offices in approximately 150 cities throughout the United States and in 107 countries worldwide. Approximately 31 percent of the sales and service offices are located in the United States. In areas where HP has no sales or service offices, it markets through more than 150 distributorships located in more than 60 countries.

*All dollar amounts are in U.S. dollars.

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HP markets approximately 70 percent of its products directly through its own sales organization. Marketing operations are supported by approximately 30,000 individuals, including field service engineers, service personnel, and administrative support staff. The remaining revenue is obtained through value-added resale channels including dealers and OEMs.

HP currently offers more than 10,000 products, which range from scientific measuring instruments to handheld calculators. HP's traditional key areas of strength have been test and measurement equipment and minicomputers. The company recently successfully established itself in the UNIX workstation market. HP possesses the key ingredients to be a major force in computer-integrated manufacturing (CIM), with its high-performance instruments, peripherals products, UNIX platforms, and networking products. Local R&D has allowed HP to quickly adapt its products to suit local European markets.

In 1990, HP announced HP NewWave Computing, a strategy to link a variety of computers in a network so they operate as one. The company has based this approach on open systems and advanced software technology, enabling users to build on computing resources currently in their possession. Other major announcements in 1990 included the HP 9000 Model 1240, the company's entrant in the emerging fault-tolerant UNIX-based computer market; the HP LaserJet III printer; and the HP 400 Series workstation, the company's first workstation developed from the combination of HP and recently acquired Apollo Computer Inc.

In November 1989, HP introduced HP NewWave Office, an integrated office system enabling users to share data and information, even with computers and software from different vendors. More than 100 software developers and resellers are supporting HP NewWave Office with a full range of word processing, spreadsheet, database, graphics, communications, and multimedia applications as well as vertical market solutions.

With the HP NewWave line, HP has unveiled its office-systems strategy for the 1990s: to deliver a complete office system that combines industry standards with emerging technologies, allowing customers to quickly and easily receive the information they need. A major part of the strategy is to integrate existing applications and systems from multiple vendors to protect customers' computing investments.

Research and development expenses totaled $1.4 billion in 1990, representing 10.3 percent of total revenue. Capital expenses reached an all-time high in 1990 of $955 million, representing 7.2 percent of total income. The R&D and capital expense totals for 1989 were $1.3 billion and $857 million, respectively, representing 10.7 and 7.2 percent of total revenue.

More detailed information is available in Tables 1 through 3, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region and distribution channel. Tables 4 through 6 at the end of this backgrounder present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

According to Dataquest estimates, HP ranked first in the 1990 worldwide traditional workstation market for 1990 with a 24.98 percent market share and $709.3 million in factory revenue. Dataquest also estimates that HP was the market leader in the medical workstation and superworkstation worldwide markets in 1990.

Technical Computers

The HP 9000 series includes desktop-size workstations and multiuser systems originally intended to be used by scientists and engineers. HP offers a wide range of workstation products, with applications including the commercial client-server marketplace, electronic publishing, computer-aided design (CAD), computer-aided manufacturing (CAM), computer-aided software engineering (CASE), and other advanced graphics markets.

In May 1991, HP introduced three new models in the HP Apollo 9000 Series 400 workstation family: the 425e, 425t, and 425s models. The Series 400 models run the HP-UX and Domain/OS operating systems and are compatible with HP's Motorola-based workstation family. The 425e is powered by Motorola's 25-MHz MC68040 processor, performs at 22.1 mips and 2.6 mflops, and offers a 2-D, frame-buffer graphics system that is tuned for X Window System performance at 2,017 operations per second (ops). The 425e has an internal storage capacity of 840MB, a total disk capacity of 9.11GB, and storage options consisting of an integrated, DOS-compatible 3.5-inch

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floppy drive or an internal CD-ROM drive. The 425e is designed for use in commercial or desktop publishing, CASE, and entry-level CAD markets.

The 425t and 425s models are more advanced models than the 425e, offering increased X Window performance at 3,100 ops. The 425t is a desktop model based on the 25-MHz MC68040 microprocessor, while the 425s is a desk-side system with increased expansion and performance capabilities. The 425s comes with four extended industry standard architecture (EISA) or three DIO-II expansion slots, and three full-height 5.25-inch storage slots for disks, CD-ROM, or digital audio tapes (DATs). Internal disk storage options range from 660MB to 3.9GB, with a maximum disk storage capacity of 27.3GB. The 425t and 425s models are targeted for mechanical-engineering and electrical-engineering design customers.

Other members of the HP Apollo 9000 family include the 300, 700, and 800 Series. The 300 Series includes HP's most basic workstation models. Introduced in March 1991, the 700 Series revolutionized performance levels in the workstation market with system performance exceeding 76 mips, the fastest on the market. The 700 Series is available in both desktop and desk-side models. The 800 Series of superminicomputers is oriented toward technical and real-time computing in the manufacturing sector and toward general-purpose UNIX computing in the government and commercial markets. These computers are based on HP Precision Architecture (HP-PA) reduced-instruction-set computing (RISC) technology, allowing users access to more than 3,500 RISC applications and tools from more than 220 independent software vendors.

In April 1989, HP acquired Apollo for $500 million. The acquisition gave HP an installed base of about 84,000 Apollo machines at almost 3,000 sites and another proprietary RISC architecture.

Business Computers

The HP 3000 series of superminicomputer systems spans a broad performance range and is designed for business data processing applications. Introduced in 1970, the 3000 Series is suited for on-line transaction processing (OLTP) and distributed processing and is compatible throughout the product line. The HP 3000 family shares the MPE operating system and uses HP's Precision Architecture in the higher-end systems. All HP 3000 computers use an open network computer philosophy for customers with a multivendor or multiarchitecture environment.

HP unveiled eight new multiuser HP 3000 systems in January 1990: 980/100, 980/200, 949, 922LX, 922RX, 922, 932, and the MICRO 3000RX. The Series 980/100 and 980/200 are the first to use advanced complementary metal-oxide semiconductor (CMOS) technology on a single VLSI chip. The 980/100 operates between 60 and 70 transactions per second (tps); and the 980/200 operates at more than 100 tps. The 922LX, 922RX, 922, and 932 perform at 7.7 tps and are designed to support 16 to 240 users in small to medium-size businesses, departments of large corporations, or branch offices. The HP MICRO 3000RX is a complete entry-level business system that can support up to 24 users. It is fully compatible with the HP 3000 product line and includes a system disk, tape cartridge, console, 16 terminal ports, operating system, database, and a menu-driven interface.

The company recently announced 10 new models for the HP 3000 line, which should be available in October 1991. These new models in the 900 Series are powered by the same Precision Architecture-RISC (PA-RISC) chips used in the 700 Series, making HP an industry leader in offering compatible RISC-based products from the desktop level to enterprisewide data center systems.

Personal Computers

Since its entry into the PC business, HP has been a high-end PC vendor aiming at the business market. The company's Vectra product line has met with considerable success since its introduction in 1986. The Vectra line consists of computers based on Intel's 80286, 80386, and 80486 microprocessors. Dataquest estimates that HP ranked 11th in the worldwide PC market in calendar year 1990, with a market share of 1.77 percent and factory revenue of $884.6 million.

The HP Vectra 486 personal computer is the highest-performing member of the HP Vectra family. It is a floor-standing unit based on the Intel i486 microprocessor. It uses the EISA, and the design optimizes performance for high-end personal computing (for example PC CAD multiuser, LAN serve) and provides the speed for high-powered single-user applications. The 486 supports up to 64MB of RAM on a single memory board, 1.3GB of mass storage, and a video graphics adapter. It comes standard with

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2MB of RAM; one 5.25-inch, 1.2MB flexible disk drive; two serial (RS-232-C) ports; one parallel (Centronics) port; connections for four flexible disks and tow-embedded hard disks; keyboard (Mini-DIN) and mouse (Mini-DIN) ports; HP disk-cache software; and memory management software. It also offers an array of hard disk drives, memory, and video products.

Dataquest estimates that the Vectra 486 PC was the third-ranked 80486 model in 1990, with $113.7 million in factory revenue and a 4.76 percent market share. HP ranked third overall in the worldwide 80486 computer market, based on $146.7 million in factory revenue and a 6.14 percent market share.

In April 1991, HP released the much-heralded HP 95LX palmtop PC, the first hand-held computer to combine PC power with the capabilities of Lotus 1-2-3 in a device the size of a business calculator. The 11oz 95LX is designed to work as a companion to desktop and laptop PCs, and will run MS-DOS 3.22 in addition to Lotus 1-2-3 Release 2.2. According to Dataquest estimates, the 95LX will propel HP into the leading position in 1991 in terms of units shipped in the notebook market.

Supercomputers and Visualization Systems

Through its Apollo Systems Division, HP offers the Apollo Series 10000 personal supercomputers and visualization systems designed for graphic-intensive applications. Both systems incorporate multiprocessing capabilities, parallel-instruction dispatch and extension, advanced-compiler technology, a RISC-based instruction set, and the capability to be configured with the IBM Token-Ring network or Ethernet as native networks. During 1990, the major components of the Series 10000 received the following upgrades: a new PRISM CPU that doubles computer power from 22 mips to 44 mips (12 mflops) per processor; parallelizing and vectorizing compilers that increase system performance two to four times; a specialized software-development environment for parallel programs and an interactive scientific-software computation and visualization environment; main memory capacity expanded fourfold, disk capacity improved by a factor of six, and local area network (LAN) bandwidth increased by a factor of 10.

Software

Although HP offers a selection of software for business and technical applications, a vital part of its Cooperative Computing Environment is the NewWave environment, which has continued to gain widespread acceptance. In May 1990, HP introduced the HP NewWave 3.0, a software applications environment that runs on any industry-compatible MS-DOS PC with an Intel 80286 or 80386 microprocessor. The HP NewWave 3.0 utilizes the enhancements made by Microsoft to Windows, including improvements to memory management and the user interface. From this, HP NewWave 3.0 requires only 2MB of extended memory to run several applications. More than 100 independent software vendors, including Micrografx Inc. and Microsoft Corporation, have committed resources to develop future HP NewWave applications. FutureSoft Engineering Inc., Lotus Development Corporation, New Media Graphics Corporation, and VideoLogic have all begun shipping NewWave. HP also has licensing agreements for HP NewWave with AT&T Computer Systems Inc., Canon Inc., Data General Corporation, and NCR Corporation.

In January 1991, HP announced that its SoftBench and Encapsulator products, which had previously only been offered for HP/Apollo workstations, would be compatible with Sun's SPARCstation computers. SoftBench is a software-development product for CASE that coordinates and controls the separate software programs that engineers use to design, build, and test software products. Encapsulator allows the customization of SoftBench through the addition of CASE tools of the user's choice. The move by HP further demonstrates the company's commitment to open systems environments.

HP released several new software products in the first half of 1991. In May, the company released HP SharedX, a distributed-computing software product that allows geographically separated work groups to view and modify information simultaneously on their UNIX-based workstations and X terminals. The program is a breakthrough in real-time computing and can be used immediately by current X Window System users with no modification to their existing systems. In June, the company released HP OpenView Interconnect Manager, a network-management program that greatly reduces mapping time on networks.

Peripherals

HP's peripherals products include video display terminals, magnetic disk and tape drives, plotters, and laser printers. HP's laser printers were first introduced in 1975. Technology exchanges and license agreements with Canon led to HP's 2680 laser printer series, which includes the 2689, an IBM-compatible version.

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HP expanded its printer product line in March 1991 with the release of the high-end HP LaserJet IIIsi printer. Designed for the business environment, the LaserJet IIIsi prints 17 pages per minute (ppm) and uses Resolution Enhancement technology and HP's PCL 5 printer language. Options include a network-printer interface card for direct connection to a LAN, a two-sided printing mechanism, and a power envelope feeder that holds up to 100 envelopes.

According to Dataquest, HP led the North American 1- to 10-ppm PNPP printer market with a 53.5 percent market share in 1990, based on $1.96 billion in factory revenue.

HP has also been a market leader in the X Window System graphics terminals market. HP released the HP 700/X family of X Window graphics terminals in 1989, and the family has continued to gain market share. The 700/X family consists of a comprehensive set of color and monochrome network-based graphics terminals based on the industry-standard X Window System from the Massachusetts Institute of Technology (MIT). The terminals are designed to operate in multivendor networked environments and provide the equivalent graphics and LAN performance of an entry-level workstation configured as an X server.

Dataquest estimates that HP ranked third in the 1990 worldwide X Window terminal market with a 12.4 percent market share and $22.3 million in factory revenue. HP was the market leader in the 1990 worldwide Color X Window market, garnering 20.3 percent of the market with $17.0 million in factory revenue.

HP also provides monitors for workstations, where Dataquest estimates that HP ranked second in the 1990 worldwide workstation monitor market, with $175.5 million in revenue and a 22.2 percent market share.

Telecommunication

HP's vision of future information technology is called the Cooperative Computing Environment. Its goal is to develop integrated networks of both general-purpose and specialized computers working together as a single, integrated system, regardless of location, vendor, or operating system. These networks will manage the simultaneous transmission of voices, data, and video. The resulting distributed system can integrate diverse applications, environments, and computers, and will allow more effective processing of information.

Semiconductors

According to Dataquest, HP ranked 21st in the 1990 North American total semiconductor market, with a market share of 1 percent. HP is the market leader in the North American optoelectronic semiconductor market, holding a 40 percent market share in 1990 with $132 million in factory revenue.

HP manufactures a number of dedicated integrated circuits (ICs) for internal consumption only. These are supported by a wide range of optoelectronic devices (both components and modules) that are generally available on the merchant market, together with several specialized diode and transistor products.

Computer Storage

HP's storage devices family includes 5.25-inch hard-disk storage systems for entry-level through high-end computer systems; digital data storage (DDS) format tape drives for HP computer systems; and a family of mass-storage systems that combine a high-capacity hard-disk mechanism with a choice of two additional drives (DAT drive, CD-ROM drive, rewritable-optical disk drive, and/or additional hard-disk drives).

Dataquest estimates that HP ranked eighth in the worldwide 5.25-inch rigid disk drive market in 1990, with a 1.7 percent market share. HP also ranked second in the worldwide 1/2-inch reel-to-reel tape drive market, with 14.9 percent of the market.

Further Information

For further information about the business segments, please contact the appropriate industry service.

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Table 1
Five-Year Corporate Highlights
(Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	7,102	8,090	9,831	11,899	13,233
Percent Change	9.18	13.91	21.52	21.04	11.21
Capital Expenditure	497	510	648	857	955
Percent of Revenue	7.00	6.30	6.59	7.20	7.22
R&D Expenditure	824	901	1,056	1,269	1,367
Percent of Revenue	11.60	11.14	10.74	10.66	10.33
Number of Employees	82,000	82,000	87,000	95,000	92,000
Revenue ($K)/Employee	86.61	98.66	113.00	125.25	143.84
Net Income	516	644	816	829	739
Percent Change	5.52	24.81	26.71	1.59	(10.86)

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	3,103	3,308	3,242	3,580
Quarterly Profit	173	186	178	202

Source: Hewlett-Packard Company
Annual Reports
Dataquest (October 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
North America	54.00	51.00	48.00	46.73	45.53
International	31.00	33.00	34.00	34.72	36.00
All Others	15.00	16.00	18.00	18.55	18.47

Source: Hewlett-Packard Company
Annual Reports
Dataquest (October 1991)

Table 3
Revenue by Distribution Channel (Percent)

Channel	1987*	1988*	1989
Direct Sales	58	60	60
Indirect Sales	42	40	40
Distributors	1	1	NA
Dealers	1	1	NA
OEMs	40	38	NA

*Computer systems only
NA = Not available

Source: Hewlett-Packard Company
Annual Reports
Dataquest (October 1991)

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1990/1991 SALES OFFICE LOCATIONS*

North America—129
Europe—111
Japan—28
ROW—191
*Includes service offices

MANUFACTURING LOCATIONS

North America

Aguadilla, Puerto Rico
Terminals
Andover, Massachusetts
Medical equipment
Avondale, Pennsylvania
Analytical instruments
Boise, Idaho
Disk drives, printers
Chelmsford, Massachusetts
Workstations
Colorado Springs, Colorado
Electronic test instruments, telecom test equipment
Corvallis, Oregon
Calculators, hand-held computers, ASICs
Cupertino, California
Minicomputers
Everett, Washington
Electronic instruments
Exeter, New Hampshire
Workstation components
Fort Collins, Colorado
Workstations, network controllers, ASICs, RISC Processors
Greeley, Colorado
Printers, tape drives
Loveland, Colorado
Logic design systems, high-frequency linear digital oscilloscopes
McMinnville, Oregon
Medical equipment
Palo Alto, California
Test equipment
Rockaway, New Jersey
Test equipment
Rohnert Park, California
Test equipment
Roseville, California
Network products, personal computers
San Diego, California
Plotters
San Jose, California
Microwave, opto, diode, transistors
Santa Clara, California
Electronic instruments, ASICs
Santa Rosa, California
Microwave test equipment, opto, diode, transistors
Spokane, Washington
Test equipment
Sunnyvale, California
Computer-integrated manufacturing systems, workstation systems integration, PCs, workstations
Waltham, Massachusetts
Medical equipment
Waterloo, Canada
X terminals, industrial terminals
Vancouver, Washington
Printers

Europe

Barcelona, Spain
Printers, drives
Bergamo, Italy
Network products
Boeblingen, Germany
Workstations, midrange computers, analytical instruments, medical instruments
Bristol, England
Disk drives
Grenoble, France
Networking products, personal computers
Lyon, France
Midrange computers
Pineswood, England
Software
South Queensferry, Scotland
Telecom test equipment, microwave test equipment
Villefontaine, France
A-series and various industrial automation and medical products, networks, telecom
Waldbronn, Germany
Analytical instruments

Japan

Hachioji, Japan
Test equipment
Kobe, Japan
Test equipment

ROW

Bangalore, India
Distribution
Guadalajara, Mexico
PCs, multiuser systems

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Penang, Malaysia
Semiconductor devices
Singapore
Software networks, printers, graphics imaging components, calculators, keyboards, terminals, optoelectronic LED components
Seoul, South Korea
Instruments, peripherals, distribution
Taipei, Taiwan
Asian language PC products
Aguadilla, Puerto Rico
Printed circuit devices

SUBSIDIARIES

North America

Apollo Computer Inc. (United States)
Apollo World Trade Inc. (United States)
Applied Optoelectronic Technology Corp. (United States)
EON Systems Inc. (United States)
Fleet Systems Inc. (United States)
Hewlett-Packard Atlantic Inc. (United States)
Hewlett-Packard (Canada) Ltd. (Canada)
Hewlett-Packard Delaware Inc. (United States)
Hewlett-Packard Delaware Funding Inc. (United States)
Hewlett-Packard Delaware Holding Inc. (United States)
Hewlett-Packard Delaware Investment Inc. (United States)
Hewlett-Packard European Distribution Operations Netherlands Inc. (United States)
Hewlett-Packard Finance Company (United States)
Hewlett-Packard Hellas Inc. (United States)
Hewlett-Packard Inter-Americas Corp. (United States)
Hewlett-Packard Laboratories Japan Inc. (United States)
Hewlett-Packard Pipeline Co. (United States)
Hewlett-Packard Puerto Rico (United States)
Hewlett-Packard World Trade Inc. (United States)
IDACOM Electronics Inc. (United States)
The Tall Tree Insurance Company (United States)

Europe

Geneva Investments N.V. (Netherlands Antilles)
Hewlett-Packard A/S (Denmark)
Hewlett-Packard (Austria) Ges.m.b.H. (Austria)
Hewlett-Packard Belgium S.A.N.V. (Belgium)
Hewlett-Packard Benelux B.V. (Netherlands)
Hewlett-Packard DDR (Germany)
Hewlett-Packard Equipment Leasing Ltd. (Great Britain)
Hewlett-Packard Espanola S.A. (Spain)
Hewlett-Packard Finance Ltd. (Great Britain)
Hewlett-Packard France (France) Hewlett-Packard GmbH (Germany)
Hewlett-Packard International Sales Corporation B.V. (Netherlands)
Hewlett-Packard Ireland Ltd. (Ireland)
Hewlett-Packard Italiana S.p.A. (Italy)
Hewlett-Packard Leasing Ltd. (Great Britain)
Hewlett-Packard Ltd. (Great Britain)
Hewlett-Packard Nederland B.V. (Netherlands)
Hewlett-Packard Norge A/S (Norway)
Hewlett-Packard OY (Finland)
Hewlett-Packard Product Leasing Ltd. (Great Britain)
Hewlett-Packard S.A. (Switzerland)
Hewlett-Packard (Schweiz) A.G.
Hewlett-Packard Singapore (PTE) Ltd. (Singapore)
Hewlett-Packard Sverige A.B. (Sweden)
Hewlett-Packard Technical B.V. (Netherlands)
Hewlett-Packard Trading S.A. (Switzerland)
IDACOM Electronics (Germany)

Japan

Yogokawa Hewlett-Packard Design Systems Laboratory Ltd. (Japan)
Yokogawa Hewlett-Packard Ltd. (Japan)

ROW

Applied Optoelectronic Technology (Asia) PTE Ltd. (Singapore)
Applied Optoelectronic Technology Taiwan Ltd. (Taiwan)
Arrendadora Hewlett-Packard S.A. de C.V. (Mexico)
China Hewlett-Packard Company Ltd. (China)
China Hewlett-Packard (Shenzhen) Company Ltd. (China)
E.I. Industria e Cuercio S.A. (Brazil)
Grupo Hewlett-Packard S.A. de C.V. (Mexico)
Hewlett-Packard Argentina S.A. (Argentina)
Hewlett-Packard Asia Pacific Limited (Hong Kong)
Hewlett-Packard Australia Finance Ltd. (Australia)
Hewlett-Packard Australia Ltd. (Australia)
Hewlett-Packard Bilgisayar Ve Olcum Sistemleri Anonim Sirketi (Turkey)
Hewlett-Packard de Venezuela C.A. (Venezuela)
Hewlett-Packard do Brasil S.A. (Brazil)
Hewlett-Packard Far East Pte. Ltd. (Singapore)
Hewlett-Packard FPG (China)
Hewlett-Packard Hong Kong Ltd. (Hong Kong)

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Hewlett-Packard (India) Private Ltd. (India)
Hewlett-Packard (India) Software Operation Private Ltd. (India)
Hewlett-Packard Investment Ltd. (Liberia)
Hewlett-Packard (Malaysia) SDN.BHD. (Malaysia)
Hewlett-Packard Malaysia Technology, Sdn. Bhd. (Malaysia)
Hewlett-Packard (N.Z.) Ltd. (New Zealand)
Hewlett-Packard Penang Sdn. Bhd. (Malaysia)
Hewlett-Packard S.A. de C.V. (Mexico)
Hewlett-Packard Sales (Malaysia) Sdn. Bhd.
Hewlett-Packard Singapore (Sales) Pte. Ltd. (Singapore)
Hewlett-Packard Taiwan Ltd. (China)
Hewlett-Packard (Thailand) Ltd. (Thailand)
Hewlett-Packard USSR (USSR)
Moriya Pty. Inc. (Australia)
Samsung Hewlett-Packard Ltd. (Korea)
Sispar Participacoes Ltda. (Brazil)
Telecom Hewlett-Packard Pty. Ltd. (Australia)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Computer Associates International Inc.
HP and Computer Associates agreed to codevelop systems management, database, and applications software for HP's 9000 Series computers that run the HP/UX UNIX-based operating system.

Hermes Plus
HP and Hermes jointly formed the Yugoslavian-based Hermes Plus Company, which will market and service HP personal computers and peripherals in Yugoslavia.

Hitachi Ltd.
HP and Hitachi entered a cooperative agreement to develop expert-systems technology based on an enhanced version of Hitachi's ES/Kernel for HP's Motorola-based 9000 workstations and Precision Architecture RISC-based computers.

IBM Corporation
HP and IBM signed a licensing agreement licensing HP's SoftBench integration framework and Encapsulator software technologies for use in future CASE solutions targeted to IBM's AIX-based RISC System/6000 family of workstations and servers.

Informix Software Inc.
HP and Informix signed a five-year joint agreement to develop, market, and sell faster versions of HP hardware and Informix software primarily for OLTP and CASE.

Ithaca Software
HP and Ithaca Software agreed to a licensing arrangement under which Ithaca will incorporate HP Advanced Rendering Technology into its HOOPS graphics development system.

Lotus Development Corporation
HP and Lotus agreed to a marketing and development treaty designed to make Lotus 1-2-3 software available on HP workstations.

Mentor Graphics and Serveco
HP, Mentor Graphics, and Serveco signed an agreement to manufacture CAD systems in the Soviet Union for use in electronic equipment design. Serveco, a Soviet-Swiss joint venture, will be the distributor and servicer on the Soviet market Mentor Graphics will provide specialized CAD software and HP's USSR subsidiary (HP USSR) will manufacture the hardware.

Microsoft Corporation
HP and Microsoft signed an agreement authorizing HP to provide worldwide support for Microsoft LAN Manager, Microsoft Windows graphical environment 3.0, MS-DOS and OS/2 operating systems, and Microsoft SQL Server.

Microtest Inc.
HP and Microtest entered into an agreement in which Microtest will supply its LAN test products to HP, and HP will market them.

Mitsubishi Electric Corporation
HP and Mitsubishi signed an agreement whereby Mitsubishi will be supplied with a new RISC workstation that it will market in Japan.

Mitsumi Electric Company
HP and Mitsumi signed a contract giving HP an exclusive supply of 3.5-inch DAT mechanisms from Mitsumi for HP's 2GB and 8GB DAT drives.

Northern Telecom Limited
HP and Northern Telecom signed an agreement in which the companies will jointly market central office-based call handling capabilities based on a link between Northern's DMS-100 central office switch and HP's UNIX-based Applied Computerized Telephony.

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Panacea Inc.
HP and Panacea signed a nonexclusive licensing agreement allowing a version of Panacea's Display List Driver (DLD) to be tailored to the HP Intelligent Graphics Controllers (IGCs).

Sequoia Systems Inc.
HP extended its OEM and technology-licensing agreement with Sequoia Systems through 1994. The new agreement extends HP's exclusive marketing rights for Sequoia systems to the worldwide telecommunications market and increases the number of Sequoia's fault-tolerant systems HP is committed to sell in 1992.

Software AG
HP and the Germany-based Software AG made a marketing agreement under which Software AG's Adabas database management system, Network networking product, and Natural fourth-generation language will be made available on HP's UNIX platforms.

Sun Microsystems Inc.
HP and Sun entered a joint-development agreement to create a common, next-generation, object-oriented distributed computing environment called Distributed Application Architecture (DAA). The move brings together two of the leading operating systems in Sun's Open Network Computing (ONC) and HP's Network Computing System (NCS).

HP and Sun also signed an agreement by which HP will port its mechanical computer-aided design (MCAD) software to Sun SPARCstation workstations.

1990

Actel Corporation
HP and Actel Corporation announced that they will cooperate in developing, licensing, and manufacturing an advanced family of field programmable gate arrays (FPGAs). Under the terms of the five-year agreement, HP has immediate access to Actel's FPGA design software and will make a 5 percent equity investment in Actel.

AT&T Computer Systems
HP signed an agreement to license HP NewWave software to AT&T Computer Systems. Terms of the contract were not disclosed.

Cascade Microtech Inc.
HP purchased a minority equity position in Cascade Microtech Inc. and licensed some wafer-probing technology to Cascade.

Cognos
HP entered into an agreement with Cognos, establishing Cognos' PowerHouse fourth-generation language (4GL) software as a growth path for users of HP's RAPID and ALLBASE tool sets.

Emerald Systems Corporation
HP signed Emerald Systems to a distribution agreement in which Emerald will offer RAMP backup and restore software for use with the HP Network Mass Storage System.

Hughes Aircraft Company
HP and Hughes Aircraft Company signed a strategic agreement to develop and manufacture advanced workstations, personal computers, and other related equipment.

MAI Basic Four Inc.
MAI Basic Four became an HP VAR. Under the VAR agreement, MAI Basic Four will resell the computers with MANBASE, its MRP II (manufacturing/resource/planning) software solution to manufacturers.

McDonnell Douglas Systems Integration Co.
HP and McDonnell Douglas Systems Integration entered into a three-year, $75 million VAR agreement that allows McDonnell Douglas to resell HP's Motorola and RISC-based HP 9000 family of workstations with its Unigraphics software.

Mentor Graphics Corporation
HP and Mentor Graphics announced a multimillion-dollar software-marketing agreement. Under the terms of the agreement, HP will adapt Mentor Graphics' design and analysis software for board-test applications and will market it with future HP board-test products.

NCR/Data General/Canon
HP signed an agreement to license the HP NewWave software environment to NCR, Data General, and Canon.

Novell Inc.
HP and Novell signed a licensing agreement that will enable HP to offer Novell's Portable NetWare network operating system to users of its HP 3000 Model 900 RISC-based minicomputers.

Numetrix Inc.
HP and Numetrix Inc. signed an agreement in which Numetrix's Schedulex production scheduling software will be ported to HP 9000 Series 800 HP-PA computers and HP Vectra personal computers. HP and Numetrix will market the HP-based Schedulex software solution to process manufacturers in the food, beverage, pulp and paper, chemical, pharmaceutical, and consumer packaged goods industries.

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Octel Communications Corporation
HP and Octel Communications Corporation have become strategic partners in bringing high-performance voice-processing equipment to Europe.

Penstock Inc.
HP announced that Penstock Inc. has become a distributor of HP RF and microwave components and integrated products in the United States and Canada. Under the terms of the agreement, Penstock will focus on selling devices above 1 GHz and will stock a broad line of silicon and gallium arsenide (GaAs) beam-lead and chip devices, as well as packaged versions of these products. In addition, Penstock will have inventory of selected HP mechanical switches, programmable step attentuators, and fixed coaxial attentuators.

Sequoia Systems Inc.
HP and Sequoia Systems Inc. announced a strategic relationship that includes a marketing agreement, technology licensing, and an equity investment. Under the technology licensing agreement, HP has the right to use most of Sequoia's fault-tolerance, muiltiprocessor technology in future HP systems. The agreement also calls for the cross-licensing of any improvements to this technology by either company.

Visual Information Technologies Inc. (VITec)
HP and VITec signed an agreement to develop and market a high-end, image-processing workstation that runs on the recently introduced HP Apollo 9000 Model 400s.

1989

3Com Corporation
HP announced a strategic alliance with 3Com, which will license its OS/2-based 3+Open LAN Manager network operating system to HP. HP will sell the product under the name HP3+Open LAN Manager.

Aeritalia's Systems and RPVs Group of Italy
HP, Aeritalia's Systems, and RPVs Group of Italy signed a joint agreement to market EMC measurement systems.

AGFA Compugraphic Division
HP and AGFA Compugraphic Division jointly developed Type Director, which is based on Compugraphic's Intellifont font-scaling technology and has been implemented according to HP's specifications.

Blue Star Ltd.
HP has established Hewlett-Packard India Pvt. Ltd., a joint-venture company with Blue Star Ltd., the sole distributor of HP products in India. HP will have 40 percent equity in the venture and Blue Star 20 percent. The remaining 40 percent will be in the form of public shares to be issued in 1990.

Carlisle Memory Products Group
HP signed a $4.5 million contract that renews and expands a previous agreement to purchase Carlisle half-inch tape reels in all worldwide locations.

Compression Labs Inc. (CLI)
Compression Labs Inc. signed an agreement with HP to provide videoconferencing systems for HP's international communications network. The agreement, worth more than $2 million, calls for CLI to provide 50 videoconferencing systems over a two-year period.

Decision Data Inc. (DDI)
HP and Decision Data Inc. established an OEM agreement in which DDI intends to purchase $20 million worth of newly developed HP terminals compatible with IBM System/3X and AS/400 computers. The new terminals will be resold by Decision Data Computer Corporation, a subsidiary of DDI. The OEM terminals, developed jointly by HP and DDI, are manufactured at HP's automotated facility in Roseville, California. The terminals will be sold exclusively to DDI.

Interphase
HP, through its Apollo Division, extended its OEM agreement with Interphase for another two years at a value of approximately $2.1 million.

Microsoft Corporation
The two companies engaged in joint development to port the MS LAN Manager OS/2 technology to the UNIX system environment.

NEC Corporation
HP and NEC announced an agreement to develop comprehensive development tools for several NEC original microprocessors and microcomputers. Under the terms of the agreement, HP will develop, sell, and support HP 64700 series emulators for many of NEX's original microprocessors and microcontrollers.

National Semiconductor Corporation
HP and National Semiconductor Corporation announced joint development efforts aimed at providing integrated semiconductor and system network products that conform to the IEEE 802.3 10BASE-T network standard.

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Nellcor Inc.
HP was granted a license under Nellcor Inc.'s sensor-coding patents to use Nellcor's oximeter sensors with HP patent-monitoring systems.

Oki Electric Industry Co. Ltd.
The two companies agreed to build and operate a printed circuit board facility in Puerto Rico.

Oracle Corporation
HP, through its Apollo Division, announced a marketing agreement with Oracle under which both companies will promote and market the Oracle relational database management systems software products.

Philips Components
HP and Philips Components of the Netherlands announced an agreement to develop and make high-voltage optocouplers.

Samsung Electronics Co. Ltd.
HP and Samsung Electronics Co. in Korea formed an agreement for Samsung to develop, manufacture, and resell chip sets, workstations, and other computers using HP's RISC technology.

Sony of America
Sony of America will supply 5.25-inch rewritable optical disk storage products to HP for the HP C17QA Optical Disk Library System, the first rewritable optical disk autochanger. The Sony drive and controller will also be used for a standalone rewritable optical disk subsystem, the HP C1711A, which is fully compatible with the Optical Disk Library System.

Spatial Technology Inc.
HP and Spatial Technology Inc. agreed to jointly market solid-modeling software for the mechanical computer-aided design and computer-aided manufacturing market. HP bought about a 10 percent equity stake in Spatial.

VHA Supply Company Inc.
HP and VHA Supply Company signed a two-year extension to a three-year purchase agreement signed in 1987, covering a variety of HP medical-electronic and computer products. Under the terms of the agreement, HP will provide critical-care and diagnostic equipment as well as computer systems to VHA's national network of 669 locally owned hospitals and their 177 affiliates. Included in the critical-care equipment are the HP CareVue 9000 clinical information system and the HP Component Monitoring System.

MERGERS AND ACQUISITIONS

1991

Applied Optoelectronic Technology
HP purchased Milpitas, California-based Applied Optoelectronic Technology, thereby expanding HP's range of semiconductor test gear. AOT makes automatic testing gear for smart-power modules and integrated circuits.

1989

Apollo Computer Inc.
This merger with Apollo gave HP a strong foothold in the networking arena, with a 30.4 percent share of the 1988 workstation market. The acquisition gave HP an installed base of about 84,000 Apollo machines at almost 3,000 sites and another proprietary RISC architecture.

Optotech
HP purchased certain assets of Optotech, a privately held company that designs and develops optical disk drives.

KEY OFFICERS

David Packard
Chairman of the board

John A. Young
President, chief executive officer

Dean O. Morton
Executive vice president, chief operating officer

Richard C. Alberding
Executive vice president, Marketing and International

John L. Doyle
Executive vice president, Business Development

Richard A. Hackborn
Executive vice president, Computer Products Organization

Lewis E. Platt
Executive vice president, Computer Systems Organization

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William E. Terry
Executive vice president, Measurement Systems

Robert Wayman
Senior vice president, chief financial officer

PRINCIPAL INVESTORS

David Packard—17.1 percent
William R. Hewlett—12.2 percent

FOUNDERS

William R. Hewlett (stepped down as Vice President of board of directors, February 1987)
David Packard

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Table 4
Balance Sheet
Fiscal Year Ending October 31
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash	1,372	2,645	814	906	1,077
Receivables	1,344	1,561	1,982	2,494	2,883
Marketable Securities	0	0	118	20	0
Inventory	981	1,117	1,478	1,947	2,092
Other Current Assets	117	167	170	364	458
Total Current Assets	3,814	5,490	4,562	5,731	6,510
Net Property, Plants	2,236	2,328	2,516	2,893	3,201
Other Assets	237	315	780	1,451	1,684
Total Assets	6,287	8,133	7,858	10,075	11,395
Total Current Liabilities	1,518	2,735	2,589	3,743	4,443
Long-Term Debt	110	88	392	474	139
Other Liabilities	285	288	344	412	450
Total Liabilities	1,913	3,111	3,325	4,629	5,032
Converted Preferred Stock	0	0	0	0	0
Common Stock	712	776	234	459	739
Other Equity	0	0	0	0	0
Retained Earnings	3,662	4,246	4,299	4,987	5,624
Total Shareholders' Equity	4,374	5,022	4,533	5,446	6,363
Total Liabilities and Shareholders' Equity	6,287	8,133	7,858	10,075	11,395

Source: Hewlett-Packard Company
Annual Reports and Forms 10-K
Dataquest (October 1991)

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Table 5
Consolidated Income Statement
Fiscal Year Ending October 31
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	7,102	8,090	9,831	11,899	13,233
U.S. Revenue	3,812	4,122	4,763	5,561	6,025
Non-U.S. Revenue	3,290	3,968	5,068	6,338	7,208
Cost of Sales	3,353	3,785	4,832	6,091	6,993
R&D Expense	824	901	1,056	1,269	1,367
SG&A Expense	2,145	2,442	2,859	3,327	3,711
Capital Expense	497	510	648	857	955
Pretax Income	780	962	1,142	1,151	1,056
Pretax Margin (%)	10.98	11.89	11.62	9.67	7.98
Effective Tax Rate (%)	33.90	33.10	28.50	28.00	0
Net Income	516	644	816	829	739
Shares Outstanding, Millions	256	257	234	238	244
Per Share Data					
Earnings	2.02	2.50	3.36	3.52	3.06
Dividend	0.22	0.23	0.28	0.36	0.42
Book Value	17.09	19.54	19.37	22.88	26.08

Source: Hewlett-Packard Company
Annual Reports and Forms 10-K
Dataquest (October 1991)

Table 6
Key Financial Ratios
Fiscal Year Ending October 31

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	2.51	2.01	1.76	1.53	1.47
Total Assets/Equity (%)	143.74	161.95	173.35	185.00	179.08
Current Liabilities/Equity (%)	34.71	54.46	57.11	68.73	69.83
Total Liabilities/Equity (%)	43.74	61.95	73.35	85.00	79.08
Profitability (%)					
Return on Assets	8.21	7.92	10.38	8.23	6.49
Return on Equity	11.80	12.82	18.00	15.22	11.61
Profit Margin	7.27	7.96	8.30	6.97	5.58
Other Key Ratios					
R&D Spending % of Revenue	11.60	11.14	10.74	10.66	10.33
Capital Spending % of Revenue	7.00	6.30	6.59	7.20	7.22
Employees	82,000	82,000	87,000	95,000	92,000
Revenue ($K)/Employee	86.61	98.66	113.00	125.25	143.84
Capital Spending % of Assets	7.91	6.27	8.25	8.51	8.38

Source: Hewlett-Packard Company
Annual Reports
Dataquest (October 1991)

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Hitachi Ltd.

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4-chome, Chiyuoda-ku
Tokyo 101, Japan
Telephone: (03) 258-1111
Fax: (03) 253-2186
Dun's Number: 69-054-1503

Date Founded: 1910

CORPORATE STRATEGIC DIRECTION

Hitachi Ltd. was founded to develop indigenous Japanese electrical power equipment manufacturing technology. Initially, the company emphasized the development of heavy electrical equipment and industrial machinery. After World War II, Hitachi expanded into the consumer product area and in the 1950s entered the electronics field, producing computers, semiconductors, and other electronic devices.

Over the years, most of Hitachi's business operations involved large equipment such as power plants and industrial machinery. The plant-as-profit-center concept was the basis of the management system. Today, however, a large percentage of Hitachi's business relates to electric and electronic consumer goods, office automation equipment, and other mass-market products.

Under the new system, the business divisions make the decisions regarding product development and coordinate the work of the laboratory, plant, and sales division in all phases of the development process, from R&D to marketing. This new system created the Semiconductor Design and Development Center and the Institute of Advanced Business Systems, as well as a system for promoting the development and marketing of new products in new business fields. During 1990, the office computer system design operations, which had been split between two works, were consolidated under the newly established Center for Small-Scale Processors and Workstations Development. Thus, a new profit center was created under the wing of the computer division.

Hitachi also consolidated the operations of its subsidiaries in each of the three major regions—United States, Europe, and Asia—where the company has production and marketing bases. Hitachi also made an effort to expand production at overseas sites. As part of this expansion, a company was set up in France for manufacturing computer products. Hitachi also increased the production capacity of a number of bases in other parts of the world.

During fiscal year 1991, operating income was held back by the high value of the yen, the economic slowdown in the United States and Europe, and the transition to a new generation of products in key computer and semiconductor sectors. In order to offset these factors, Hitachi increased its plant and equipment investment by 19 percent to ¥781,488 million (U.S.$55.6 million). (Percentage changes refer only to ¥ amounts; U.S.$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Most of these funds were used to strengthen and consolidate the computer and semiconductor operations.

Hitachi's consolidated revenue of ¥7,737.0 billion (U.S.$54.8 billion) for fiscal 1991 was an increase of 10.65 percent from ¥7,077.8 billion (U.S.$49.5 billion) during fiscal 1990.

Hitachi is divided into four separate segments: Information Systems and Electronics, Power and Industrial Systems, Consumer Products, and Materials and Others. Information Systems and Electronics was the largest contributor of revenue with 34 percent or ¥2,781,351 million (U.S.$19,798 million); Power and Industrial Systems contributed 28 percent or ¥2,357,892 million (U.S.$16,783 million); Materials and Others contributed 25 percent or ¥2,100,870 million (U.S.$14,953 million); and Consumer Products contributed 13 percent or ¥1,107,388 million (U.S.$7,882 million).

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Net income increased by 10.4 percent to ¥230.2 billion (U.S.$1.6 billion) for fiscal 1991, compared with ¥211.0 billion (U.S.$1.5 billion) in fiscal 1990. The improved results were attributed to the company's steady expansion on a worldwide scale. Hitachi employs more than 290,000 people worldwide.

Research and development expenditure increased to ¥490.7 billion (U.S.$3.5 billion) and represented 6.3 percent of total revenue for the period. Over 60 percent of this expenditure was channeled into the Information Systems and Electronics division. During 1990, Advanced Research Laboratory was relocated to Saitama Prefecture, Japan. This laboratory concentrates on long-term research projects with a duration of 10 to 20 years. It is currently engaged in research in the areas of quantum measurement, software science, biotechnology, and materials science.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 7 at the end of this backgrounder provide comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Semiconductors

During calendar year 1990, Hitachi was the third largest worldwide semiconductor manufacturer with U.S.$3,893 million, representing a 6.7 percent market share. Dataquest estimates the company's single largest market to be Japan, which generated approximately U.S.$2.8 million, representing 12.1 percent of the semiconductor market during 1990. Dataquest ranks Hitachi third of all Japanese companies in this market. Hitachi's next largest market is North America, where Hitachi's sales were U.S.$517 million in calendar 1990, ranking eighth, with a 3.0 percent market share.

Hitachi was the third largest worldwide supplier of MOS memory in 1990, accounting for approximately U.S.$1,366 million in revenue worldwide. This represented a 10 percent share of the worldwide market, which is an increase of about 10 percent over 1989.

In the second half of 1990, the supply of MOS memories exceeded demand, increasing the downward pressure on prices. Therefore, as a result of industry cutbacks in the production of 1Mb DRAMs implemented in fall 1990, prices stabilized. During the latter half of 1990, there was a growing demand for 4Mb DRAMs for use in new workstations and 32-bit personal computers. According to Dataquest estimates, Hitachi increased its DRAM market share from 8.5 percent in 1989 to 9.7 percent in 1990, and the company ranked fourth worldwide in DRAM production, accounting for U.S.$697 million in revenue.

Computers

During fiscal 1990, Hitachi introduced the large-scale general-purpose HITACHI M-880 Processor Group. This system will become a mainstay product in Hitachi's computer operations. In addition, the technology involved will be applied extensively in other products. During 1990, in the business computer market, Hitachi had a 12.45 percent worldwide market share and ranked third in supercomputers. In mainframes, it ranked second with a 7.40 percent worldwide market share. In the technical computer market, Hitachi had a 2.09 percent worldwide market share and ranked tenth in supercomputers. In mainframes, it ranked third with a 7.79 percent worldwide market share. In the personal computer market, Hitachi had less than one percent of the market.

Computer Storage

In addition to introducing the HITACHI M-880, the company also introduced the H-6587 series of mass-storage magnetic disk storage subsystems for large computers. Dataquest estimates that Hitachi ranks third in the worldwide total optical disk drive market with 11.5 percent of the market and U.S.$23.4 million in 1990 revenue. In the CD-ROM optical disk drive market, Hitachi ranks second worldwide with revenue of U.S.$10.4 million and a market share of 17.5 percent. Hitachi also ranks third in the worldwide 12-inch WORM optical disk drive market with a 20 percent market share and U.S.$13 million in revenue.

Other Products

Hitachi's Power and Industrial Systems witnessed a 5 percent increase in fiscal 1990 sales over 1989. The main contributing factors were a higher level of industrial demand accompanying the continuing

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expansion of the domestic economy. Sales in Hitachi's Consumer Products division grew 10 percent in 1990 from 1989. In Japan, sales were derived from air conditioners, washing machines, and 8mm camera/recorders. Although overseas sales were severely affected by the depressed state of the U.S. market, there was a recovery in exports of color television sets and VCRs to China and brisk exports to the USSR and Eastern Europe. The Materials and Others division posted an increase of 12 percent over 1989. Hitachi Cable Ltd. achieved an increase in sales based on a combination of strong domestic demand, mostly from the electric equipment and construction industries and brisk exports. At Hitachi Metals Ltd., sales were pushed up by demand from the automobile and electronics-related industries. Active business in the electronics equipment and industries, plus a high level of new housing starts, led to increased sales for Hitachi Chemical Co. Ltd. The major part of the service sector business was derived from Hitachi Transport System. The continuing driving pace of the Japanese economy generated strong demand for freight-hauling services and produced an increase in company sales.

Further Information

For further information pertaining to the company's business segments, please contact the appropriate Dataquest industry service.

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Table 1
Five-Year Corporate Highlights (Billions of U.S. Dollars)

	1987	1988	1989	1990	1991
Five-Year Revenue	30.4	36.0	49.9	49.5	54.8
Percent Change	34.19	18.61	38.48	(0.79)	10.65
Capital Expenditure	4.1	2.7	4.0	3.6	5.3
Percent of Revenue	13.56	7.49	8.04	7.27	9.61
R&D Expenditure	1.9	2.3	2.9	3.0	3.5
Percent of Revenue	6.34	6.51	5.83	6.07	6.34
Number of Employees	161,325	159,910	274,508	290,000	310,000
Revenue ($K)/Employee	0.19	0.23	0.18	0.17	0.18
Net Income	0.6	1.0	1.4	1.5	1.6
Percent Change	38.67	60.22	46.02	2.01	10.43
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1987	1988	1989	1990	1991
Japan	73.82	76.00	77.05	76.58	76.02
International	26.18	24.00	22.95	23.42	23.98

Source: Hitachi, Ltd.
Annual Reports
Dataquest (November 1991)

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1991 SALES OFFICE LOCATIONS

North America—2
Europe—2
Asia/Pacific—61
Japan—50
ROW—9

MANUFACTURING LOCATIONS

North America

High Voltage Breakers, Norcross, Georgia
SF6 gas breakers
Hitachi Automotive Products, Farmingtonhills, Michigan
Electronic auto parts
Hitachi Cable Manchester Inc., Manchester, New Hampshire
Cables
Hitachi Cable Manchester Inc., New Albany, Indiana
Automobile brake hose
Hitachi Computer Products (America), Norman, Oklahoma
Computer products (magnetic disk devices, magnetic tape cartridges)
Hitachi Construction Machinery Corp., Brampton, Ontario
Excavators, cranes, tunnel shield machines
Hitachi Electronic Devices USA Inc., Greenville, South Carolina
Color picture tubes
Hitachi Home Electronics of America, Anaheim, California
Color TVs, VCRs
Hitachi Denshi (Canada) Ltd., Scarborough, Ontario
Broadcast and professional video, CCTV equipment, test and instrumentation
Hitachi (HSC) Canada Inc., Pointe Claire, Quebec
TVs, VCRs, and household electric appliances
Hitachi Instruments Inc.
Medical instruments
Hitachi Semiconductor (America), Irving, Texas
Semiconductors
Hitachi Telecom, Norcross, Georgia
Digital PBXs

Europe

Hitachi Consumer Products (Europe), Germany
VCRs
Hitachi Consumer Products (U.K.), United Kingdom
Color TVs
Hitachi Semiconductor Europe, Germany
Semiconductors

Asia/Pacific

Akita Electronic Co., Akita, Japan
MOS, bipolar IC
Hanshi Electric, Japan
Ignition coils for automobiles
Haramachi Semiconductor Ltd., Ibaraga, Japan
Diodes, thyristors
Hitachi Computer Engineering, Japan
Development of automatic designing systems
Hitachi Consumer Products, Malaysia
TV parts
Hitachi Consumer Products, Singapore
Color TVs, audio equipment, vacuum cleaners
Hitachi Consumer Products, Thailand
Electric fans, refrigerators, TVs, motors, air conditioners, electric rice cookers
Hitachi Cubu Electric, Japan
Switchboards
Hitachi Denshi, Japan
Communications equipment, measuring instruments, information equipment
Hitachi Electronic Devices, Singapore
Color CRTs
Hitachi Electronics Engineering, Japan
Information equipment, semiconductor devices, energy-saving equipment
Hitachi Elevator Engineering, Singapore
Elevators, escalators
Hitachi Engineering, Japan
Electric/electronic equipment, plant engineering
Hitachi Haramachi Semiconductor, Japan
Semiconductor parts
Hitachi Kiden Kogyo, Japan
Cranes, water treatment equipment, FA-related equipment
Hitachi Kyowa Kogyo, Japan
Electric equipment
Hitachi Maxell, Japan
Dry batteries, magnetic tapes, electronic devices
Hitachi Medical, Japan
Medical equipment
Hitachi Microcomputer Engineering, Tokyo, Japan
MPUs, ASICs
Hitachi Mizusawa, Japan
Transformers for TVs
Hitachi Naka Seiki, Japan
Chromatographic equipment, scientific instruments
Hitachi Nissin Electronics, Japan
Electronic parts

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Hitachi Ohira Industrial, Japan
Parts for refrigerators, air conditioners
Hitachi Process Computer Engineering, Japan
Process computers
Hitachi Semiconductor, Malaysia
Semiconductors
Hitachi Setsubi Engineering, Japan
FA equipment
Hitachi Techno Engineering, Japan
Electronic part manufacturing equipment
Hitachi Telecom Technologies, Japan
Switching systems
Hitachi Television, Taiwan
Color TVs, audio equipment, displays
Hitachi Video Engineering, Japan
Development of video equipment
Hitachi Works, Ibaraga, Japan
Discrete devices
Hitachi Yomezawa Electronic, Japan
Semiconductor elements
Hokkai Semiconductor, Hokkaido, Japan
SRAMs
Horiba Ltd., Japan
Electric measuring instruments
Japan Servo, Japan
Precision motors
Jidosha Denki Kogyo, Japan
Electrical auto parts
Kaohsiung Hitachi Electronics, Taiwan
Electronic parts, transistors, LCDs
Kokusai Electric, Japan
Electric communications equipment
Kokusan Denki, Japan
Electrical auto parts, generators, motors
Komoro Works, Nagano, Japan
Photo devices, hybrid ICs
Mobara Works, Chiba, Japan
DRAMs, CMOS logic, LCDs
Musashi Works, Tokyo, Japan
MPUs, diodes, DRAMs, SRAMs
Naka Works, Ibaraga, Japan
Semiconductor sensors, DRAMs, SRAMs
Nakayo Telecommunications, Japan
Telephone and switching systems
Nigata Works, Nigata, Japan
Linear, bipolar digital ICs
Nippon Columbia, Japan
Records, stereos, and other audio equipment
Nissin Electronics Ltd., Ibaraga, Japan
MOS
Taga Sangyo, Japan
Electric equipment
Taiwan Hitachi, Taiwan
Room air conditioners
Takasaki Works, Gunma, Japan
Bipolar and MOS ICs, EPROMs, CMOS logic
Tobu Semiconductor Ltd., Aomari, Japan
Bipolar ICs
Tobu Semiconductor Ltd., Saitama, Japan
Transistor, hybrid ICs
Tokico Ltd., Japan
Electrical auto parts and equipment
Tokyo Electronics Co., Yamanashi, Japan
Diodes, bipolar ICs
Yagi Antenna, Japan
Antennas
Yomezawa Electronic Co., Yamagata, Japan
MOS

ROW

Industrias Hitachi, Brazil
Distribution equipment, air conditioners, electronic parts, transformers, switches
Hitachi Consumer Products de Mexico, Mexico
Televisions

SUBSIDIARIES

North America

Hitachi America Ltd. (United States)
Hitachi Automotive Products (USA) Inc. (United States)
Hitachi (Canadian) Ltd. (Canada)
Hitachi Computer Products (America) Inc. (United States)
Hitachi Electronic Devices (United States)
Hitachi Farmington Technical Center (United States)
Hitachi Home Electronics of America Inc. (United States)
Hitachi Micro Systems Inc. (United States)
Hitachi Semiconductor (America) Inc. (United States)
Hitachi Telecom (USA) Inc. (United States)

Europe

Hitachi Consumer Products Europe Ltd. (United Kingdom)
Hitachi Semiconductor Europe (Germany)
Hitachi Consumer Products (Europe) (Germany)

Asia/Pacific

Asahi Kogyo Co. Ltd. (Japan)
Babcock-Hitachi K.K. (Japan)
Chuo Shoji Ltd. (Japan)

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Hitachi Air Conditioning & Refrigeration Co. Ltd. (Japan)
Hitachi Australia Ltd. (Australia)
Hitachi Automobile Appliances Sales Co. Ltd. (Japan)
Hitachi Cable Ltd. (Japan)
Hitachi Chemical Co. Ltd. (Japan)
Hitachi Construction Machinery Co. Ltd. (Japan)
Hitachi Consumer Products (Malaysia) Sdn. Bhd. (Malaysia)
Hitachi Consumer Products Pte. Ltd.
Hitachi Credit Corporation (Japan)
Hitachi Electronic Components (Asia) Ltd. (Hong Kong)
Hitachi Electronic Devices (Singapore) Pte. Ltd. (Singapore)
Hitachi Denshi Ltd. (Japan)
Hitachi Electronics Engineering Co. Ltd. (Japan)
Hitachi Electronics Service Co. Ltd. (Japan)
Hitachi Elevator Engineering and Service Co. Ltd. (Japan)
Hitachi Engineering Co. Ltd. (Japan)
Hitachi Heating Appliances Co. Ltd. (Japan)
Hitachi Higashi Shohin Engineering Ltd. (Japan)
Hitachi Hokkai Semiconductor Ltd. (Japan)
Hitachi Kiden Kogyo Ltd. (Japan)
Hitachi Lighting Ltd. (Japan)
Hitachi Machinery and Engineering Ltd. (Japan)
Hitachi Maxell Ltd. (Japan)
Hitachi Medical Corporation (Japan)
Hitachi Metals Ltd. (Japan)
Hitachi Mokuzai Jisho Ltd. (Japan)
Hitachi Nishi Shohin Engineering Ltd. (Japan)
Hitachi Plant Engineering & Construction Co. Ltd. (Japan)
Hitachi Power Engineering Co. Ltd. (Japan)
Hitachi Printing Co. Ltd. (Japan)
Hitachi Sales Corporation (Japan)
Hitachi Seiko Ltd. (Japan)
Hitachi Semiconductor (Malaysia) Sdn. Bhd. (Malaysia)
Hitachi Service Engineering Co. Ltd. (Japan)
Hitachi Software Engineering Co. Ltd. (Japan)
Hitachi Techno Engineering Co. Ltd. (Japan)
Hitachi Telecom Technologie Ltd. (Japan)
Hitachi Television Ltd. (Taiwan)
Hitachi Tochigi Electronics Co. Ltd. (Japan)
Hitachi Tohbu Semiconductor Ltd. (Japan)
Hitachi Tokyo Electronics Co. Ltd. (Japan)
Hitachi Transport System Ltd. (Japan)
Hitachi Welfare Service Ltd. (Japan)
Japan Servo Co. Ltd. (Japan)
Nippon Business Consultant Co. Ltd. (Japan)
Nissei Sangyo Co. Ltd. (Japan)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Texas Instruments Inc., Fujitsu Ltd., and Sony Corporation

Texas Instruments, Fujitsu, and Sony, along with Hitachi Ltd., have agreed to collaborate on HDTV chip development. Texas Instruments will be doing the frame memory store, Fujitsu the signal processors, Sony the analog components, and Hitachi the audio circuits. The full Muse chip set is scheduled for completion during the first quarter of 1992.

Bull CP8 S.A.

Bull CP8 S.A., a subsidiary of Groupe Bull, located in Trappes France, has signed Hitachi Ltd. as the first Japanese licensee of its self-programmable one-chip microcomputer (SPOM) patent. Hitachi's chips for microcomputer cards will be made available in Japan through Tokyo-based SPOM Japan KK, a joint venture between Bull CP8 and Dai Nippon Printing Co. Ltd, and worldwide through Hitachi's overseas sales office.

Dongfang Power Corp.

Hitachi Ltd. is planning to supply thermal power plant construction technology to Dongfang Power Corp., a Chinese company located in Sichuan Province. Under a 10-year agreement with the Chinese company, Hitachi will provide technology relating to steam turbines and generator for use in 600,000kw class thermal power stations. The two companies will then jointly construct four power plants.

TRW Inc.

Hitachi Ltd. and TRW Inc. formed a 15-year strategic alliance to jointly pursue opportunities in space systems and related ground systems and technologies. The two companies signed an agreement to set up a management team that will meet periodically to review future space programs, market opportunities, and technology requirements.

Ultra-Network Technologies

Ultra-Network Technologies, a U.S. network system manufacturer, and Hitachi Ltd. have formed a software agreement. The agreement will allow Hitachi to port ULTRANET software, a high-speed network software package developed by Ultra-Network, to its mainframe computers. The new

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version of ULTRANET will run under Hitachi's VOS3 operating system.

Hewlett-Packard Company
Hewlett-Packard Company (HP) and Hitachi Ltd. have agreed to jointly develop an artificial intelligence software product based on Hitachi's ES/Kernel expert systems technology. The new software will run on HP 9000 UNIX workstation as well as on Hitachi workstations.

National Semiconductor Corporation
National Semiconductor Corporation and Hitachi Ltd. have signed a 10-year patent cross-licensing agreement that covers all semiconductor products and technologies developed by either company in the past and during the course of the agreement. The new agreement expands and replaces a previous cross-licensing agreement between the two companies concerning FACT logic products.

Goldstar Electron Company Ltd.
Hitachi Ltd. licensed Lucky Goldstar Group's Goldstar Electron Company Ltd. to fabricate 4Mb memory chips to Hitachi's design. Part of the output will be sold back to Hitachi.

1990

Comparex Information Systems GmbH
Comparex Information Systems GmbH agreed to ship Hitachi's new Integrated Vector Feature for its 8/9X series of processors.

VLSI Technology Inc.
Hitachi plans to supply SRAMs to VLSI Technology on an OEM basis. The SRAMs have been jointly developed by the two companies.

Kansai Electric Power Co., Matsushita Electric Industrial Co. Ltd., Toshiba Corporation, Mitsubishi Electronics Corporation, Sumitomo Electric Industries Ltd., Kawasaki Heavy Industries Ltd., and Kobe Steel Ltd.
Hitachi agreed to set up a new company, which will perform research and development for free electron lasers with the preceding companies.

Sears, Roebuck and Company
Hitachi agreed to let Sears market its VY15A video printer.

1989

Sun Microsystems Inc.
Hitachi licensed Sun's Open Network Computing/Network File System technology for implementation on Hitachi's mainframe computers.

Zuken Inc.
Hitachi agreed to allow Zuken to develop CAD/CAM/CAE software packages for the 2050G Series of engineering workstations made by Hitachi.

Adaptive Information Systems (AIS)
AIS has been formed by Hitachi to market document image processing systems using optical storage technology.

Hewlett-Packard
Hewlett-Packard is licensing its proprietary Precision Architecture to Hitachi. The two companies also agreed to jointly develop a new set of chips using HP's proprietary Precision Architecture RISC MPU technology.

Texas Instruments Inc.
Texas Instruments supplied SRAMs to Hitachi on an OEM basis.

GoldStar
Hitachi signed a major pact with South Korea's GoldStar Company covering 1Mb DRAMs, for which Hitachi will provide technical consultations and manufacturing technology. Hitachi will get royalty payments from GoldStar and eventually will buy chips to sell under its own label.

Cray
This agreement gives each company the right to make use of the other's patents in designing computer hardware.

National Semiconductor
Under this production agreement for FACT logic devices, both companies can mutually produce independently defined and independently developed new functions.

MERGERS AND ACQUISITIONS

1991
Hitachi has made no merger or acquisition in 1991.

1990

Dataproducts Corporation
Two Hitachi affiliates, Hitachi Koki and Nissei Sangyo, acquired Dataproducts Corporation for approximately $160 million. Dataproducts

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manufactures a broad range of band, dot matrix, laser, solid ink, and thermal printers, and a wide range of printer supplies. Dataproducts is counting on solid ink jet printers to play a significant role in the printer industry and is investing heavily to finance this strategically important technology. The 1988 acquisition of Imaging Solutions Inc. gave Dataproducts 100 percent ownership of this new technology. Dataproducts had sales of $353 million in fiscal 1989.

National Advanced Systems
Hitachi purchased National Advanced Systems from National Semiconductor Corporation. The name of the company was changed to Hitachi Data Systems. The company markets and services mainframe computers and peripheral subsystems.

KEY OFFICERS

Katsushige Mita
Chairman and representative director

Tsutomu Kanai
President and representative director

Yutaka Sonoyama
Executive vice president and representative director

Sutezo Hata
Executive vice president and representative director

Takeo Miura
Executive vice president and representative director

Toshi Kitamura
Executive vice president and representative director

Tadashi Okita
Executive vice president and representative director

Iwao Matsuoka
Executive vice president and representative director

PRINCIPAL INVESTORS

Nippon Life Insurance—3.8 percent
Sumitomo Trust—2.7 percent
Mitsubishi Trust—2.7 percent
Dai-ichi Life Insurance—2.6 percent

FOUNDERS

Namihei Odaira

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Table 3
Balance Sheet
Fiscal Year Ending in March
(Billions of U.S. Dollars)

Balance Sheet	1987	1988	1989	1990	1991
Cash	5.6	8.0	12.8	13.0	11.7
Receivables	6.3	7.8	10.7	11.2	13.0
Marketable Securities	2.9	3.0	3.0	2.3	2.7
Inventory	5.6	7.0	9.7	9.5	11.3
Other Current Assets	1.1	1.4	1.7	1.8	2.0
Total Current Assets	21.6	27.2	38.0	37.7	40.7
Net Property, Plants	7.4	8.2	11.5	12.0	14.1
Other Assets	4.4	5.3	4.6	4.9	5.6
Total Assets	33.4	40.7	54.1	54.6	60.4
Total Current Liabilities	14.3	17.4	24.8	23.2	26.2
Long-Term Debt	3.1	3.1	4.1	6.2	6.3
Other Liabilities	2.2	2.8	3.8	3.5	3.7
Total Liabilities	19.6	23.3	32.6	32.9	36.2
Converted Preferred Stock	0	0	0	0	0
Common Stock	0.9	1.3	1.7	1.7	1.9
Other Equity	1.3	1.8	2.5	2.5	2.9
Retained Earnings	9.3	11.5	13.6	13.7	15.1
Total Shareholders' Equity	11.4	14.6	17.8	17.9	19.9
Minority Interests	2.3	2.8	3.7	3.8	4.3
Total Liabilities and Shareholders' Equity	33.4	40.7	54.1	54.6	60.4
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending in March
(Billions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	30.4	36.0	49.9	49.5	54.8
Japanese Revenue	22.4	27.3	38.4	38.1	40.8
Non-Japanese Revenue	8.0	8.7	11.5	11.6	13.1
Cost of Sales	23.0	28.7	35.5	35.1	38.4
R&D Expense	1.9	2.3	2.9	3.0	3.5
SG&A Expense	6.0	7.5	11.0	10.7	12.8
Capital Expense	4.1	2.7	4.0	3.6	5.3
Pretax Income	1.6	2.4	3.8	3.7	4.0
Pretax Margin (%)	5.33	6.66	7.67	7.49	7.27
Effective Tax Rate (%)	57.50	56.10	56.10	53.90	51.20
Net Income	0.6	1.0	1.4	1.5	1.6
Shares Outstanding, Millions	2,816.3	2,921.7	3,017.7	3,072.8	3,273.7
Per Share Data					
Earnings	0.21	0.32	0.46	0.43	0.44
Dividend	0.06	0.07	0.07	0.06	0.06
Book Value	0	0.01	0.01	0.01	0.01
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

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Table 5
Balance Sheet
Fiscal Year Ending in March
(Billions of Yen)

Balance Sheet	1987	1988	1989	1990	1991
Cash	892.9	1,103.9	1,638.3	1,853.7	1,648.5
Receivables	1,010.6	1,080.7	1,372.2	1,594.3	1,833.9
Marketable Securities	470.6	412.3	385.1	324.8	384.9
Inventory	898.5	960.6	1,250.0	1,355.0	1,597.1
Other Current Assets	172.2	199.9	224.4	263.1	286.6
Total Current Assets	3,444.8	3,757.4	4,870.0	5,390.9	5,751.0
Net Property, Plants	1,179.1	1,133.0	1,473.1	1,708.9	1,985.7
Other Assets	704.1	730.7	594.4	705.3	789.3
Total Assets	5,327.9	5,621.1	6,937.5	7,805.1	8,526.0
Total Current Liabilities	2,288.5	2,399.0	3,183.5	3,314.9	3,694.3
Long-Term Debt	488.9	432.8	520.9	886.8	891.0
Other Liabilities	352.3	381.9	481.0	494.0	520.1
Total Liabilities	3,129.7	3,213.7	4,185.4	4,695.7	5,105.4
Converted Preferred Stock	0	0	0	0	0
Common Stock	141.2	180.3	219.4	246.9	269.7
Other Equity	199.6	244.4	322.0	357.8	410.4
Retained Earnings	1,485.0	1,593.9	1,740.3	1,956.1	2,131.0
Total Shareholders' Equity	1,825.8	2,018.6	2,281.7	2,560.8	2,811.1
Minority Interests	372.4	388.8	470.4	548.6	609.5
Total Liabilities and Shareholders' Equity	5,327.9	5,621.1	6,937.5	7,805.1	8,526.0
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports and
Dataquest (November 1991)

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Table 6
Consolidated Income Statement
Fiscal Year Ending in March
(Billions of Yen, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	4,848.7	4,975.0	6,401.4	7,077.8	7,737.0
Japanese Revenue	3,579.3	3,781.0	4,932.3	5,420.1	5,881.6
Non-Japanese Revenue	1,269.4	1,194.0	1,469.1	1,657.7	1,855.4
Cost of Sales	3,675.0	3,961.9	4,552.1	5,023.5	5,417.2
R&D Expense	307.6	324.0	373.5	429.4	490.7
SG&A Expense	958.8	1,032.4	1,416.1	1,533.2	1,813.4
Capital Expense	657.4	320.4	532.4	514.9	743.4
Pretax Income	258.3	331.1	491.1	530.0	562.1
Pretax Margin (%)	5.33	6.66	7.67	7.49	7.27
Effective Tax Rate (%)	57.50	56.10	55.50	53.10	51.70
Net Income	98.7	136.8	185.6	211.0	230.2
Shares Outstanding, Millions	2,816.3	2,921.7	3,017.7	3,072.8	3,273.7
Per Share Data					
Earnings	33.45	44.14	58.94	61.71	65.96
Dividend	9.00	9.00	9.00	9.00	9.00
Book Value	0.65	0.69	0.76	0.83	0.86
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

Table 7
Key Financial Ratios
Fiscal Year Ending in March

Key Financial Ratios	1987	1988	1989	1990	1991
Liquidity					
Current (Times)	1.51	1.57	1.53	1.63	1.56
Total Assets/Equity (%)	291.81	278.47	304.05	304.79	303.30
Current Liabilities/Equity (%)	125.34	118.84	139.52	129.45	131.42
Total Liabilities/Equity (%)	171.42	159.20	183.43	183.37	181.62
Profitability (%)					
Return on Assets	1.85	2.43	2.68	2.70	2.70
Return on Equity	5.41	6.78	8.13	8.24	8.19
Profit Margin	2.04	2.75	2.90	2.98	2.98
Other Key Ratios					
R&D Spending % of Revenue	6.34	6.51	5.83	6.07	6.34
Capital Spending % of Revenue	13.56	6.44	8.32	7.27	9.61
Employees	161,325	159,910	274,508	290,000	290,000
Revenue (¥K)/Employee	30.06	31.11	23.32	24.41	26.68
Capital Spending % of Assets	12.34	5.70	7.67	6.60	8.72
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

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International Business Machines Corporation

Corporate Headquarters
Old Orchard Road
Armonk, New York 10504
Telephone: (914) 765-1900
Fax: (914) 765-4190, 765-4191
Dun's Number: 00-136-8083

Date Founded: 1911

CORPORATE STRATEGIC DIRECTION

International Business Machines (IBM) Corporation was founded in 1911 as the Computing-Tabulating-Recording Company. In 1924, the company merged with International Business Machines Corporation and retained the IBM name. Today, the company is the world's largest manufacturer of data processing machines and information-handling systems.

Acknowledged as the largest computer systems vendor in the world, IBM designs, manufactures, sells, and supports an array of information processing systems. IBM's product line includes the following:

- Mainframes
- Superminicomputers
- Mini- and microcomputers
- Workstations
- Personal computers
- Systems software
- Display terminals
- Computer storage devices
- Communications systems
- Printers
- Typewriters
- Educational and training materials
- Related supplies and services

In addition to offering these products, IBM is a major systems integration vendor, providing clients with complete solutions to information processing needs.

IBM is pursuing a three-part strategy of operations, which is designed to establish the company as a leader in emerging areas of technology while enhancing its strength in the traditional markets. This strategy includes an increased customer focus, a strengthened product line with more competitive offerings, and a pledge toward improved efficiency and market-driven quality.

In meeting its goal of intensifying the company's focus on the customer, IBM has added over 28,000 marketing and service people in the last five years. This increased service force has taken aim at increasing responsiveness to the customer's needs, taking steps such as increasing continuity in support and increasing attention to the special needs of international customers.

IBM significantly strengthened its product line in 1990 with a number of notable new products. Foremost on the list was the introduction of the System/390 family, hailed by IBM as the most successful introduction in company history. The System/390 family provides customers with increased processing power, better network management, and improved communication among multivendor systems. Also introduced in 1990 were the RISC System/6000 family of high-performance workstations; entry-level models of the Application System/400 processors for small and medium-size businesses or departments; two high-end models of the Personal Computer/2 (PS/2); the PS/1 home computer; and new software products such as CallPath Services Architecture, an integration tool for voice and data communications, and the ImagePlus High Performance Transaction System, which converts documents into electronic images that can be transmitted, stored, retrieved, and printed.

In the interest of company efficiency, IBM has been undergoing a number of changes in the past several years, designed to compensate for changing market conditions and user demand. IBM has trimmed

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employee and administrative costs and sold off several subsidiaries, enabling the company to concentrate on its core businesses. In the last five years, IBM has reduced its worldwide employee population by over 33,000 people. At the end of fiscal 1990, the employee total was reduced to 373,816, down almost 10,000 from the 1989 year-end total of 383,220.

In a major alliance between the world's two largest personal computer manufacturers, IBM and Apple Computer Inc. announced in July of 1991 that they aim to jointly develop and market new technologies that will integrate into their existing and future products. The major points in this letter of intent are as follows:

- IBM and Apple intend to create a new open system software platform that will be based on object-oriented technology. To market this platform, IBM and Apple will form a new systems software company that will be jointly owned and independently managed. Software will be offered for sale on IBM and Apple computers as well as for other vendors' systems.
- The Apple Macintosh computer will be integrated into IBM's new enterprise client/server environment. The two companies will develop, market, and support networking and communications products for this environment. IBM and Apple will also develop and market an enhanced version of IBM's AIX operating system that will integrate the best features of the AIX and Macintosh operating systems. The application range for the operating system will span from desktops to servers.
- Apple intends to adopt future single-chip implementations of IBM's RS/6000 POWER architecture. Motorola and IBM will use their expertise to design and manufacture this new family of POWER PC chips, with Motorola acting as a source for the chips.
- IBM and Apple plan to work together to create and license a multimedia platform-independent software environment.

Both companies hope to complete and sign contracts for the announced partnership by the end of 1991.

IBM began to see the fruits of the company's efforts to streamline its operations in the financial results of 1990. IBM's revenue for the fiscal year ending December 31, 1990, totaled $69.0 billion, up 10.0 percent from the 1989 year-end revenue of $62.7 billion. Net income rose 60.2 percent to $6.0 billion in 1990, up from the $3.8 billion total in 1989. The company points to the effects of the strategic restructurings as a major reason for the increased profitability.

International sales revenue reached an all-time high in 1990, totaling $41.9 billion in 1990 and accounting for 60.7 percent of total sales. U.S. sales increased 5.4 percent in 1990 to $27.1 billion, accounting for 39.3 percent of total revenue.

IBM spent $6.6 billion on research and development in 1990, representing 9.5 percent of total revenue. Capital expenses totaled $27.2 billion, also representing 39.5 percent of total revenue.

IBM divides its operations into the following primary operating units: seven Lines of Business (LOBs), consisting of Application Business Systems, Application Solutions, Networking Systems, Enterprise Systems, Personal Systems, Programming Systems, and Technology Products; IBM United States, which provides marketing services and support to customers in the United States; IBM World Trade, which provides service and support to international customers, as well as working closely with the LOBs to develop and manufacture products on an international level; Research, which engages in the research and development of new products; and the IBM Credit Corporation, which provides both customer and dealer financing for IBM products and services in the United States.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 5, at the end of this backgrounder, present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

The structure of IBM's seven LOBs is as follows:

- Personal Systems—Desktop systems, typewriters, displays, printers

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- Application Business Systems—Midrange systems, storage devices
- Enterprise Systems—All System/390 products, high-volume printers, storage subsystems
- Technology Products—Worldwide development and U.S. manufacturing of logic and memory technology and the electronic packaging used throughout the IBM product line
- Networking Systems—Communications products, information network services
- Programming Systems—Development of data management and application development software, development and implementation of Systems Application Architecture (SAA)
- Application Solutions—Hardware, software, and service solutions for customers in a broad range of businesses, including the manufacturing, finance, and public sectors

In fiscal 1990, 97.2 percent of IBM's consolidated revenue came from its Information Technology (IT) segment. The IT segment is made up of six classification groups: Processors, Workstations, Peripherals, Software, Maintenance Services, and Other. The Processors classification is defined by user-programmable equipment having the capability of manipulating data arithmetically or logically and making calculations in a manner directly addressable by the user through the operation of a stored program. IBM defines Workstations as personal systems, typewriters, and other display-based terminals. Peripherals includes printers, storage, and telecommunications devices. Software consists of both applications and systems software, and "Other" consists mainly of customer solution services, financing revenue, and supplies.

The following lists Dataquest's industry segmentation of IBM's product lines:

- Microcomputer systems, consisting of PC hardware
- Business computer systems, consisting of mainframe, midrange, superminicomputers and minicomputers for business applications
- Technical computers, technical workstations, and supercomputers
- Telecommunications, consisting of communications controllers, networking and telecommunications products
- Display terminals
- Electronic printers
- Computer storage
- Office systems
- Software
- Semiconductors
- CAD/CAM

Microcomputer Systems

IBM continued to be the worldwide leader in the personal computer market in 1990 with strong sales of its PS/2 products. Dataquest estimates that IBM held 15.25 percent of the 1990 worldwide PC market based on factory revenue and 11.85 percent based on total shipments. The PS/2 Model 55SX was the leading model in 1990, netting $2.1 million in factory revenue and a 4.12 percent market share, according to Dataquest estimates. In the North American PC market, IBM also remained the market leader with a 16.92 percent market share based on revenue and a 13.29 percent share based on units shipped. During 1990, IBM announced two new high-end models of the PS/2 computer, as well as the PS/1 personal home computer.

Business Computer Systems

IBM remains the number one manufacturer and supplier in the business computer marketplace. Sales of the popular AS/400 line of business computers remained strong in 1990, and the new Enterprise System/9000 family was also well received.

In the business mainframe segment, IBM retained its leading position in 1990, amassing $15.2 billion in factory revenue and controlling a 58.69 percent market share. IBM looks to strengthen its position further in this market with the release of six new high-end models of the Enterprise System/9000 family late in 1991.

IBM's superminicomputer line was enhanced with the April 1991 introduction of the AS/400 9404 D10, D20, and D25 models. These low-end models of the AS/400 line offer significant improvement over the C10, C20, and C30 models introduced in early 1990. IBM estimates that relative system performance in the 9404 D models is increased by as much as 55 percent over the 9404 C models. Improvements in the D models include increased processor performance, additional main storage capacity, and a standard 525MB 1/4-inch tape drive for system backup.

Technical Computers

Dataquest estimates that IBM was the market leader in the technical mainframe market with a market share of 20.8 percent and $2.5 billion in factory

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revenue. IBM also ranked second in the worldwide supercomputing market with a 21.6 percent market share, based on estimated sales of $380.0 million. This sales total represents a 27.1 percent increase over the 1989 sales revenue of $299.0 million. IBM has continued to emphasize the importance of the rapidly emerging supercomputer market, scheduling releases of new high-end Enterprise System/9000 models for mid-1991.

IBM ranked fourth in 1990 in both the superworkstation market and the traditional workstation market, with respective market shares of 8.1 percent and 10.1 percent. IBM took a major step toward strengthening its workstation product line with the introduction of the RS/6000 series in the first quarter of 1990. Using IBM's proprietary RISC microprocessor and the AIX version of the UNIX operating system, the RS/6000 offers an impressive price/performance ratio and a wide variety of software applications. The RS/6000 series is designed for customers seeking high-performance systems capable of running applications developed for a UNIX operating system. With the 1991 introduction of the POWERserver 950, the RS/6000 family includes 13 models at various performance levels.

Telecommunications

In 1990, IBM continued to assert itself as a solid contributor to the telecommunications market with the release of CallPath Services Architecture, a system providing customers with a framework with which to integrate voice and data communications. CallPath effectively integrates telephone communications on the 9750 Business Communications System with transaction processing on the Enterprise Systems host. As a result, users can quickly access customer profiles, streamline incoming call processing, track caller information, improve customer service, and reduce costs.

In other telecommunications applications, IBM retained its market-leading position atop the North American token-ring network information center (NIC) LAN market with a 76.8 percent market share, based on 639,000 units shipped. IBM also ranked fifth in the United States modem market, with a market share of 8.0 percent and $81.0 million in factory revenue.

Display Terminals

Dataquest estimates that IBM retained its lock on the worldwide display terminal market in 1990, with a 22.6 percent market share based on unit shipments of 1.4 million. IBM continues to dominate the 3270 and 5250 display terminal markets, with market shares of 49.9 percent and 71.1 percent, respectively. IBM also ranks fourth in the emerging X Window terminal market with an 8.9 percent market share.

Electronic Printers

IBM ranked second in the 1990 North American overall printer market, with market share of 12.4 percent, based on factory revenue totaling $1.1 billion. In the line printer segment, IBM maintained its market leadership in 1990 with a 34.7 percent market share and $269.6 million in end-user revenue. The company also ranked first in the impact, SIDM-18 wire/pin, LIFF, and 21- to 30-pages-per-minute (ppm) PNPP printer segments, with respective market shares of 18.2, 58.2, 67.2, and 43.4 percent.

IBM's printer offerings are segmented into nonimpact and impact products. The nonimpact line includes the 3800, 3900, and 4000 series of printers, with speeds varying from 10 to 229 ppm. At the low end, IBM offers the 4028 Page Printer, a 10-ppm desktop page printer that offers letter-quality text through the use of an internal RISC processor. At the high end is the 3900 Advanced Function Printer, a channel-attached, high-speed fanfold printer that uses an electrophotographic printing process to print at speeds of up to 229 ppm.

IBM's line of impact printers includes the 4248, 4245, 3262, and 6262 printers, with rated speeds of 600 to 4,000 lines per minute (lpm). The 4248 Printer Model 2 uses hammer magnet technology and an etched-steel print band to print at multiple speeds of 2200, 3200, and 4000 lpm. The 4245 and 6262 series offer a wide range of medium-to-high speed impact band printers. On the low end, the 3262 Line Printer offers flexibility and price/performance for users with low- to midrange print requirements.

Computer Storage

IBM's product line in the mainframe disk storage device area consists of the 3380 and 3390 Direct Access Storage Device (DASD), first introduced in 1989. The 3390 is a 14-inch rigid disk drive system that provides up to 22.7-billion-byte capacity and 4.2 MB/sec. transfer rate. IBM's 3390 is one of the

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fastest, largest-capacity mainframe disk storage devices currently available. Accordingly, Dataquest estimates that IBM was the market leader in the 1990 8-to-14-inch rigid disk drive market, with a market share of 21.2 percent.

In the area of magnetic tape drives, IBM's latest offering is the 3490 Magnetic Tape Subsystem. The 3490 is a 1/2-inch tape cartridge product, with a cartridge capacity of 200MB and a transfer rate of 3 MB/sec. Dataquest estimates that IBM ranks second in the total 1/2-inch tape drive market, with a market share of 27.9 percent.

In the 1990 rigid disk storage markets, IBM held onto its third place position in the overall market with an 8.9 percent market share. In the 3.5-inch market, which IBM led as recently as 1988, the company dropped from third place in 1989 to fourth place in 1990, behind Conner Peripherals, Seagate Technology, and Quantum Corp. IBM's unit shipments remained relatively constant in 1990, increasing 9.1 percent to 2.4 million units. The company's market share dropped from 19.0 percent in 1989 to 10.9 percent in 1990, however, reflecting a 50 percent growth rate in the overall market.

Office Systems

IBM continues to rank among the market leaders in integrated office systems (IOS). IBM's main offering in this product area is the OfficeVision family, a series of office systems first introduced in 1989. OfficeVision is an SAA-compliant office system that offers a wide range of office applications for mail, address book, calendar management, library services, document processing, and decision support. OfficeVision is supported on IBM's MVS, VM, OS/400, and OS/2 LAN. The LAN version uses OS/2 Extended Edition to provide its graphical user interface, multitasking capabilities, and program-to-program communications. Through OfficeVision, IBM continues to emphasize its SAA commitment to provide a consistent platform for the development of easy-to-use, well-connected systems and applications.

Software

The emergence of the first of a series of products under IBM's SAA first occurred in 1989. The SAA strategy was designed to provide users with a common interface and connectivity across all IBM operating environments. This strategy is the cornerstone of IBM's product plans for the next decade. IBM will use SAA to integrate current product platforms with future products, unifying all software under a single architecture.

OfficeVision was the first application to incorporate the SAA guidelines. Another SAA-based product that has prospered since its introduction in 1989 is CIM Advantage, a family of products for use in manufacturing operations. IBM has continued to emphasize the importance of the SAA environment, with recent releases such as the AD/Cycle product, a set of application development tools for use with the MVS systems environment that further supports the SAA framework. In addition, IBM's SAA standard has been endorsed by more than 100 other software companies that have committed to developing products using the SAA guidelines.

IBM also strengthened its commitment to the Open Software Foundation (OSF) and the UNIX operating system marketplace. In March 1990, IBM began shipments of the AIX operating system on PS/2 products. IBM has also stepped up AIX development through its IBM business partners program. The announcement of the AIX CASE Version 3 for the RS/6000 computer erased any lingering doubts about IBM's commitment to UNIX. Version 3 of AIX CASE offers a set of software solutions and products that support the software development process for engineering, scientific, and commercial applications.

According to IBM estimates, software revenue totaled $9.95 billion in 1990, up 18.1 percent from the 1989 total of $8.4 billion. The 1990 figure represented 14.4 percent of total revenue. IBM has continued to emphasize its role as a leader in the software industry through software agreements with companies such as Apple Computer Inc., Borland International Inc., GO Corporation, Hewlett-Packard Company, Interleaf Inc., Lotus Development Corp., and Software Artistry Inc.

Semiconductors

Traditionally, IBM has not been a merchant supplier of semiconductors, and the total extent of the company's semiconductor manufacturing has been unknown. Dataquest estimates that IBM supplies at least one-half of its own semiconductors and would rank among the top three manufacturers worldwide. The July 1991 agreement with Apple Computer Inc. has opened the door on what could be a major shift in

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IBM's semiconductor strategy. One aspect of the deal is sale of IBM's R6000 RISC microprocessor to Apple, which IBM has admitted could be the beginning of future sales of semiconductor products to other companies.

IBM has also shifted its semiconductor strategy in the past couple of years by entering technology exchange and research agreements with other companies. In a major alignment in 1990, IBM and Siemens AG teamed up to develop and market 64Mb DRAM technologies. IBM is also working with Motorola on the use of X-ray lithography technology.

In mid-1990, IBM completed construction on its new $750 million Advanced Semiconductor Technology Center (ASTC) in East Fishkill, New York. Two-thirds of the center is devoted to general chip manufacturing research, while the remaining third of the center will be utilized in IBM's research on the use of X-ray lithography technology. IBM feels that the ASTC is critical to the company's ability to develop and fabricate future generations of high-density computer chips. The company continues to emphasize the importance of the center through the allocation of over $1 billion annually in semiconductor R&D spending.

CAD/CAM

IBM remained the market leader in the overall CAD/CAM/CAE market with factory revenue of $1.8 billion and a market share of 12.4 percent. IBM was strongest in the host/server segment of the market, garnering a 35.6 percent market share with revenue totaling $1.4 billion. CIM Advantage, the company's service providing over 50 computer-integrated-manufacturing (CIM) products and applications, continued to prosper in 1990. The offering comprises hardware and software products that integrate design, engineering, production planning, and plant operations with business planning, marketing, and distribution.

Further Information

For further information about the company's business segments, please contact the appropriate industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	51,250.0	54,217.0	59,681.0	62,710.0	69,018.0
Percent Change	2.39	5.79	10.08	5.08	10.06
Capital Expenditure	21,310.0	22,967.0	23,426.0	24,943.0	27,241.0
Percent of Revenue	41.58	42.36	39.25	39.78	39.47
R&D Expenditure	5,221.0	5,434.0	5,925.0	6,827.0	6,554.0
Percent of Revenue	10.19	10.02	9.93	10.89	9.50
Number of Employees	403,508	389,348	387,112	383,220	373,816
Revenue ($K)/Employee	127.01	139.25	154.17	163.64	184.63
Net Income	4,789.0	5,258.0	5,806.0	3,758.0	6,020.0
Percent Change	(26.94)	9.79	10.42	(35.27)	60.19

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	14,185.0	16,495.0	15,277.0	23,061.0
Quarterly Profit	1,037.0	1,410.0	1,112.0	2,461.0

Source: IBM
Annual Reports
Dataquest (November 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
North America	49.49	45.99	42.43	41.05	39.31
International	50.51	54.01	57.57	58.95	60.69

Source: IBM
Annual Reports
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1991 SALES OFFICE LOCATIONS

North America—280
Japan—Not available
Europe—Not available
Asia/Pacific—Not available
ROW—Not available

MANUFACTURING LOCATIONS

North America

Boca Raton, Florida
PS/2 workstations, displays, printers, typewriters, publishing and consumer systems, and related operating systems software

Boulder, Colorado
PS/2 workstations, displays, printers, typewriters, publishing and consumer systems, and related operating systems software

Charlotte, North Carolina
PS/2 workstations, displays, printers, typewriters, publishing and consumer systems, and related operating systems software

Danbury, Connecticut
Circuit packaging, intermediate processors, and printers; develops programming systems

Essex Junction, Vermont
Major manufacturing facility; direct products not available

Hopewell Junction, New York
PS/2 workstations, displays, printers, typewriters, publishing and consumer systems, and related operating systems software

Lexington, Kentucky
Major manufacturing facility; direct products not available

Raleigh, North Carolina
Communications products and related operating systems software

San Jose, California
Electronic data processing systems, storage systems, mass storage systems, tape disk drive products

Somers, New York
Communications products and related operating systems software

White Plains, New York
Small and intermediate systems, general-purpose systems and related programming, direct access storage devices, typewriters, printers, copiers, logic memory, special semiconductor devices, and multilayer ceramics

Europe

Greenloch, Scotland
Personal computers

SUBSIDIARIES

North America

Canada Limited (Canada)
IBM Americas/Far East Systems Corp. (United States)
IBM Credit Corp. (United States)
IBM Credit Leasing Corp. (United States)
IBM Foreign Sales Corp. Ltd. (United States)
IBM International Corp. (United States)
IBM Roece Inc. (United States)
IBM Southeast Asia Services Ltd. (United States)
IBM World Trade Corp. (United States)
IBM World Trade Europe/Middle East/Africa Corp. (United States)
Satellite Transponder Leasing Corp. (United States)
WTC Insurance Corp. Ltd. (United States)

Japan

IBM Japan Ltd.
IBM World Trade Asia Corp.

Europe

Compagnie IBM France S.A. (France)
Companhia IBM Portuguesa S.A. (Portugal)
IBM Danmark A/S (Denmark)
IBM Deutschland GmbH (Netherlands)
IBM Distribution and Support S.A. (Spain)
IBM Eurocoordination S.A. (Spain)
IBM Europe S.A. (Spain)
IBM Hellas Information Handling Systems S.A. (Spain)
IBM Ireland Ltd. (Ireland)
IBM Italia Ltd. S.p.A. (Italy)
IBM Latin American Region S.A. (Spain)
IBM Nederland N.V. (Netherlands)
IBM Oesterreich Internationale Bueromaschinen Gessellschaft GmbH (West Germany)
IBM of Belgium S.A. (Belgium)
IBM S.A.E. (Spain)
IBM Svenska Aktiebolag (Sweden)
IBM Switzerland (Switzerland)
IBM Trade Development S.A. (Spain)

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IBM United Kingdom Holdings Ltd. (United Kingdom)
Oy IBM AB (Finland)

Asia/Pacific

IBM Australia Ltd. (Australia)
IBM China/Hong Kong Corp. (Hong Kong)
IBM Korea Inc. (Korea)
IBM Korea Systems Corp. (Korea)
IBM New Zealand Ltd. (New Zealand)
IBM Philippines Inc. (Philippines)
IBM Singapore Pte. Ltd. (Singapore)
IBM Taiwan Corp. (Taiwan)
IBM Thailand Co. Ltd. (Thailand)
Thai Systems Corp. Ltd. (Thailand)

ROW

IBM Argentina S.A. (Argentina)
IBM Bahamas Ltd. (Bahamas)
IBM Brasil-Industria, Maquinas E Servicos Ltda. (Brazil)
IBM De Bolivia S.A. (Bolivia)
IBM De Chile S.A.C. (Chile)
IBM De Colombia S.A. (Colombia)
IBM De Costa Rica S.A. (Costa Rica)
IBM De Guatemala S.A. (Guatemala)
IBM De Honduras S.A. (Honduras)
IBM Del Ecuador C.A. (Ecuador)
IBM Del Peru S.A. (Peru)
IBM Del Uruguay S.A. (Uruguay)
IBM De Mexico S.A. (Mexico)
IBM De Panama S.A. (Panama)
IBM De Venezuela S.A. (Venezuela)
IBM Israel Ltd. (Israel)
IBM Turk Ltd. Sirketi (Turkey)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Apple Computer Inc.
IBM and Apple signed a landmark agreement to develop and market new technologies that will integrate with their existing and future products.

Borland International Inc.
IBM and Borland agreed to adapt current Borland tools and languages to run on IBM's OS/2 2.0 operating system.

K-C Computer Services Corp.
IBM and K-CCS signed a licensing agreement and will jointly market CSP/Application Development Enabler, a K-CCS product that enhances IBM's Cross System product.

Lotus Development Corporation
IBM agreed to market Lotus' Notes software into its Office Vision office automation platform.

Micrografx Inc.
IBM and Micrografx signed a licensing and development agreement designed to improve the compatibility and performance of OS/2.

Motorola
IBM and Motorola signed a licensing agreement covering integrated circuit chip mounting technologies.

Novell Inc.
The two companies agreed to a product licensing, distribution, and support relationship in which IBM will include Novell's NetWare products in its family of network offerings.

Siemens AG
Siemens and IBM signed a technology agreement involving the development and marketing of 64Mb DRAM technologies.

Tandon Corporation
The two companies will jointly develop and cross-license PC technoloogy.

Valid Logic Systems Inc.
The two companies signed an agreement in which Valid will develop an integrated process for system-level electronic design at IBM development labs worldwide.

Wang Laboratories Inc.
IBM and Wang signed a deal in which Wang will market IBM computers, assisting Wang customers in replacing their Wang minicomputers with IBM models.

1990

3Com Corporation
IBM and 3Com entered a joint development agreement that will define a new set of network management specifications for mixed-media local area networks.

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Delphi Technology Inc.
IBM and Delphi signed an agreement in which IBM will manufacture automated photo machines (APMs) for Delphi.

Diebold Inc.
IBM and Diebold formed a joint venture that will provide self-service banking systems worldwide.

Digitalk Inc.
The two companies signed a development and licensing agreement that licenses Digitalk's OS/2 implementation of Smalltalk/V and future Digitalk offerings for prototyping and product development.

GO Corporation
IBM and GO signed a software licensing agreement under which GO will provide IBM with software technology for the development of future computers that are operated by a pen.

Hewlett-Packard Company
IBM and HP signed a licensing agreement for technology related to computer-aided software engineering (CASE).

Index Technology Corporation
IBM and Index entered into new agreements to develop AD/Cycle business tools that use IBM's Repository Manager/MVS host product, PS/2, and OS/2 EE workstation platforms.

Interleaf Inc.
IBM and Interleaf entered into a joint development agreement to create a Japanese version of Interleaf software for use on the IBM RS/6000.

Micro Focus Inc.
IBM and Micro Focus announced a distribution agreement that will offer users of IBM's Customer Information Control System (CICS) a more efficient way to develop and test CICS applications by using the CICS OS/2 operating system.

Rockwell International Corp.
IBM's Systems Integration Division and Rockwell's Collins Defense Communications business entered into an agreement to produce advanced digital signal processing devices containing VHSIC technology.

Software Artistry Inc.
IBM named Software Artistry as an IBM Cooperative Software Supplier under the IBM Cooperative Software program. The three products specifically targeted in the agreement are Software Artistry's PC Expert Professional, Application Software Expert, and the Knowledge Engine.

Sun Microsystems Inc.
Sun and IBM signed a patent cross-license agreement, granting each company a worldwide, nonexclusive license covering patents having an effective filing date before July 1, 1995.

U.S. Trust Corp.
IBM and U.S. Trust Corporation formed a joint venture that will provide integrated information systems solutions to trust banks and other customers in the financial services industry.

1989

Toshiba Corporation
IBM and Toshiba entered into a joint venture to produce lightweight computer screens.

NCR Corporation
IBM and NCR entered into an MCA licensing agreement.

Wang Laboratories
IBM and Wang entered into an MCA licensing agreement.

Haushahn GmbH
IBM and Haushahn GmbH will be jointly developing an automated tape-drive library.

Samsung Electronics Company Ltd.
The companies entered into a patent cross-licensing agreement.

Baxter International
IBM and Baxter International are codeveloping computer products and services for the rapidly growing health-care information management market.

Motorola Incorporated
IBM and Motorola entered into a joint development of a national X-ray lithography program.

Micron Technology Inc.
IBM has licensed 4Mb DRAM technology from Micron Technology.

Microsoft Corporation
IBM and Microsoft Corporation are codeveloping an open industry standard for multimedia personal computing systems.

Chips & Technologies Inc.
IBM and Chips & Technologies are codeveloping and marketing chip sets that are used in busmasters and other Micro Channel adapter cards.

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Intel Corporation
IBM and Intel are codeveloping and marketing Micro Channel chip sets.

Modicon
IBM and Modicon have signed a development and marketing alliance in which Modicon will support mutual development of products that move Modicon controller and communication products and IBM industrial computer products.

1988

Siemens AG
IBM and Siemens have joined forces to compete in the global PBX and private networking markets. (As a part of this agreement, IBM sold its ROLM subsidiary to Siemens.)

MERGERS AND ACQUISITIONS

1991

Metaphor Computer Systems Inc.
IBM acquired Metaphor to provide graphical user interface technology for the new Apple/IBM venture.

KEY OFFICERS

John F. Akers
Chairman of the board, chief executive officer

Jack D. Kuehler
President

***C. Michael Armstrong**
Chairman of the board, senior vice president, and president of World Trade Corporation

Walton E. Burdick
Senior vice president of Personnel

George H. Conrades
Senior vice president and general manager of IBM U.S.

Carl J. Conti
Senior vice president and general manager, Enterprise Systems

Donato A. Evangelista
Senior vice president and general counsel

***Terry R. Lautenbach**
Senior vice president

David E. McKinney
Senior vice president

***Frank A. Metz, Jr.**
Senior vice president, Finance and Planning

Stephen B. Schwartz
Senior vice president, market-driven quality

Patrick A. Toole
Senior vice president and general manager, worldwide manufacturing and development operations

Earl F. Wheeler
Senior vice president and general manager, Programming Systems

*Members of management committee

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Table 3
Balance Sheet
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Balance Sheet	1986	1987	1988	1989	1990
Cash	755.0	770.0	1,072.0	741.0	1,189.0
Receivables	10,825.0	13,849.0	18,100.0	20,164.0	22,644.0
Marketable Securities	6,502.0	6,197.0	5,051.0	1,261.0	698.0
Inventory	8,039.0	8,645.0	9,565.0	9,463.0	10,108.0
Other Current Assets	1,628.0	1,559.0	1,555.0	4,246.0	4,281.0
Total Current Assets	27,749.0	31,020.0	35,343.0	35,875.0	38,920.0
Net Property, Plants	21,268.0	22,922.0	23,426.0	24,943.0	27,241.0
Other Assets	8,797.0	9,746.0	14,268.0	16,916.0	21,407.0
Total Assets	57,814.0	63,688.0	73,037.0	77,734.0	87,568.0
Total Current Liabilities	12,743.0	13,377.0	17,387.0	21,700.0	25,276.0
Long-Term Debt	4,169.0	3,858.0	8,518.0	10,825.0	11,943.0
Other Liabilities	6,528.0	8,190.0	7,623.0	6,700.0	7,517.0
Total Liabilities	23,440.0	25,425.0	33,528.0	39,225.0	44,736.0
Converted Preferred Stock	0	0	0	0	0
Capital Stock	6,321.0	6,417.0	6,442.0	6,341.0	6,357.0
Other Equity	219.0	2,830.0	1,917.0	1,691.0	3,241.0
Retained Earnings	27,834.0	29,016.0	31,150.0	30,477.0	33,234.0
Total Shareholders' Equity	34,374.0	38,263.0	39,509.0	38,509.0	42,832.0
Total Liabilities and Shareholders' Equity	57,814.0	63,688.0	73,037.0	77,734.0	87,568.0

Source: IBM
Annual Reports
Dataquest (November 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	51,250.0	54,217.0	59,681.0	62,710.0	69,018.0
U.S. Revenue	25,362.0	24,937.0	25,320.0	25,745.0	27,132.0
Non-U.S. Revenue	25,888.0	29,280.0	34,361.0	36,965.0	41,886.0
Cost of Sales	16,197.0	17,332.0	25,648.0	27,701.0	30,723.0
R&D Expense	5,221.0	5,434.0	5,925.0	6,827.0	6,554.0
SG&A Expense	15,464.0	16,431.0	19,362.0	21,289.0	20,709.0
Capital Expense	21,310.0	22,967.0	23,426.00	24,943.0	27,241.0
Pretax Income	8,389.0	8,609.0	8,746.0	6,645.0	10,203.0
Pretax Margin (%)	16.37	15.88	14.65	10.60	14.78
Effective Tax Rate (%)	42.90	38.90	39.20	43.4	41.0
Net Income	4,789.0	5,258.0	5,806.0	3,758.0	6,020.0
Shares Outstanding, Millions	612.8	602.9	592.4	581.1	572.6
Per Share Data					
Earnings	7.81	8.72	9.27	6.47	10.51
Dividend	4.40	4.40	4.40	4.73	4.84
Book Value	56.09	63.46	66.69	66.27	74.80

Source: IBM
Annual Reports
Dataquest (November 1991)

Table 5
Key Financial Ratios
Fiscal Year Ending in December

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	2.18	2.32	2.03	1.65	1.54
Total Assets/Equity (%)	168.19	166.45	184.86	64.77	204.45
Current Liabilities/Equity (%)	37.07	34.96	44.01	56.35	59.01
Total Liabilities/Equity (%)	68.19	66.45	84.86	201.86	104.45
Profitability (%)					
Return on Assets	8.28	8.26	7.95	4.83	6.87
Return on Equity	13.93	13.74	14.70	9.76	14.05
Profit Margin	9.34	9.70	9.73	5.99	8.72
Other Key Ratios					
R&D Spending % of Revenue	10.19	10.02	9.93	10.89	9.50
Capital Spending % of Revenue	41.58	42.36	39.25	39.78	39.47
Employees	403,508	389,348	387,112	383,220	373,816
Revenue ($K)/Employee	127.01	139.25	154.17	163.64	184.63
Capital Spending % of Assets	36.86	36.06	32.07	32.09	31.11

Source: IBM
Annual Reports
Dataquest (November 1991)

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Matsushita Electric Industrial Co. Ltd.

1006 Kadoma, Kadoma City
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Telephone: (06) 908-1121
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Dun's Number: 69-053-6552

Date Founded: 1918

CORPORATE STRATEGIC DIRECTION

Matsushita Electric Industrial Co. Ltd. was founded as a family business in 1918 by Konosuke Matsushita to produce and market an electric adapter plug for consumer products. Today, Matsushita is a worldwide electric and electronics manufacturer with products that range from consumer electronics equipment, home appliances, and housing-related products through sophisticated industrial and communications equipment, including electronic components.

Matsushita is currently divided into four major business segments. These segments are discussed below:

Audiovisual (AV) Products and Home Appliances

The audiovisual products and home appliances segment is Matsushita's core business. Matsushita strengthened its position as a digital video industry leader by introducing its composite digital 1/2-inch tape VCR system (D3) for broadcast use. This system will be used as the official system for the 1992 Barcelona Olympic Games.

Further advances in intelligent products are expected in home appliances. With Matsushita's success of appliances employing fuzzy logic and neuro-fuzzy logic, the company is working to develop next-generation technologies. It is pursuing basic R&D into artificial intelligence and home-use robots.

Information and Communications Equipment

In systems and networks, Matsushita has made advances in urban cable TV (CATV) systems, as well as in airport traffic control systems and subway information management systems that use optical fiber LANs. The company is also increasing installations of AV information networks employing satellite signals. To meet emerging markets, such as integrated services digital network (ISDN)-related products and systems and intraorganizational information systems, the company is currently constructing the Tokyo Information and Communications Development Center.

Construction Electronics

Matsushita is a major manufacturer of virtually all of the key equipment needed in homes, offices, and other buildings, including air-conditioning equipment, gas water-heating equipment, kitchen-related products, lighting fixtures and elevators, as well as appliances and communications equipment used in the home. Drawing on its capabilities as a manufacturer of a comprehensive range of products, Matsushita is using this approach to develop a totally integrated package concept and proposing it to the construction industry. To foster this concept, the company established the Construction Electronics Business Group.

Components and Industrial Goods

Matsushita supplies a vast array of electronic components including semiconductors. The company is also one of Japan's leading suppliers of factory automation equipment. It plans to continue developing a well-balanced semiconductor business, stressing not only memory devices but also bipolar ICs, microprocessors, logic ICs and charge-coupled devices.

Within the four major segments, Matsushita has six major product categories: video equipment, communications and industrial equipment, electronic components, home appliances, audio equipment, and batteries and kitchen-related products.

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Matsushita's products are sold in more than 160 countries under the brand names National, Panasonic, Technics, and Quasar and under other trade names including JVC.

The company reported consolidated sales of $46.7 billion* for the fiscal year ended March 31, 1991. Net income for the year increased over 13 percent, to $1.8 billion, versus $1.6 billion in fiscal 1990. International sales accounted for 45 percent of revenue in fiscal 1991. Within the major product categories, video equipment sales increased 9 percent; audio equipment sales rose 8 percent; home appliances sales increased 13 percent; communications and industrial equipment had a sales growth of 14 percent; electronic components' sales grew 9 percent; and batteries and kitchen-related products had sales gains of 13 percent. (Note: Percentage growth figures apply to U.S. dollar-based growth.)

In December 1990, Matsushita acquired MCA Inc. for approximately $6.1 billion. MCA Inc. is a leading U.S. entertainment company, which includes Universal Pictures Production. It engages primarily in the film, music, and publishing business. MCA's strength in the production of film and music software will widen Matsushita's business scope in the audiovisual field.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 7 at the end of this backgrounder provide comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Video Equipment

The video equipment category remains Matsushita's largest revenue producer, accounting for 26 percent of fiscal 1991 revenue. Sales totaled $12,144 million for this period. This category includes VCRs, camcorders and related equipment; color, projection, and liquid crystal display televisions; videodisc players; and satellite broadcast receivers.

*All dollar amounts are in U.S. dollars.

Communications and Industrial Equipment

The second-largest revenue-producing category for the company is communications and industrial equipment. This category accounted for 24 percent of fiscal 1991 revenue. Total sales increased 14 percent over the previous period to $11.0 billion and include Matsushita's targeted growth areas of information/communication and factory automation. Products include facsimile and copier equipment, PCs and workstations, printers, telephones and private branch exchange systems, industrial robots, electronic parts mounting equipment, welding machines, air conditioners, and compressors.

Computers

Matsushita has expanded its desktop and laptop PC lines, resuming exports to Europe and North America, which were curtailed in 1987. The company is manufacturing 8-, 16-, and 32-bit IBM-compatible laptops in Japan, under the Panasonic label, for sale in Europe. In the U.S. market, the company is selling 16- and 32-bit models made by Tandy Corporation on an OEM basis. According to Dataquest, Matsushita had less than 1 percent of the worldwide market share for desktop and laptop PCs during 1990.

Facsimiles

During 1989, Matsushita merged its Panafax Corporation into the larger Office Automation Group of Panasonic Communications & Systems Company. The company intends to expand its presence across the entire spectrum of facsimile product markets through the merger of the two groups. According to Dataquest, Panasonic facsimile sales in the North American market during 1990 were more than 95,000 units, placing Panasonic/Matsushita among the top five vendors in the market with a 6.8 percent market share.

In addition to sales by its Panasonic subsidiary, Matsushita manufactures facsimile equipment sold by Pitney Bowes Inc. and several models sold by Fujitsu, Tandy, and Telautograph.

In April 1990, Matsushita's Quasar subsidiary announced a facsimile model for sale in the U.S. market, manufactured by Matsushita in Japan.

Copiers

Selling copiers under the Panasonic label, Matsushita continued to gain market share during 1990. Panasonic copiers compete in segments 1 through 4 of the six Dataquest copier segments. Based on plain paper

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copier placements, Dataquest ranked Panasonic thirteenth in 1990, with 30.7 thousand units. In the Western European copier market, Panasonic's 1990 sales rose to a total of 24.9 thousand units, up from 23.1 for 1989.

In addition to copier sales under the Panasonic label, Matsushita manufactures several models sold under the Lanier label in the United States and under the Adler-Royal label in Europe.

Printers

Matsushita also manufactures and markets its printers under the Panasonic label. Its product line focus is primarily on the serial printer market. According to Dataquest, Panasonic ranked fourth among page printer vendors in North America during 1990, with 75.5 thousand units and a market share of 3.6 percent. In the serial printer market, the company had unit shipments of 1.2 million with a market share of 20.8 percent.

Electronic Components

The electronic components category accounted for 13 percent of Matsushita's fiscal 1991 revenue, with sales of $5,961 million. In the general components field, sales gains domestically as well as overseas were led by surface-mounted components and microwave parts used in audiovisual and mobile communications equipment, as well as parts for office automation equipment.

Semiconductors

Matsushita's 1990 worldwide semiconductor ranking went from ninth in worldwide semiconductor sales to tenth, based on revenue of $1,942 million. Its semiconductor sales include MOS digital ICs, analog devices, discrete devices, optoelectronics, and bipolar digital ICs. The total revenue and worldwide market share breakdown is as follows: MOS digital, $819 million with a 2.5 percent market share; MOS memory, $284 million with a 2.2 percent market share; MOS microcomponents, $250 million with a 2.5 percent market share; MOS logic, $285 million with a 3.1 percent market share; analog devices, $410 million with a 3.9 percent market share; discrete devices, $374 million with a 4.5 percent market share; and optoelectronics, $325 million with a 12.1 percent market share.

Home Appliances

The home appliances category accounted for 14 percent of total revenue during the 1991 fiscal year. Sales for the period were $6,370 million, up 13 percent from $5,614 million for the previous period.

Products in the home appliances category include refrigerators, room air conditioners, laundry equipment, vacuum cleaners, electric irons, microwave ovens, electric fans, electric blankets, and cooking appliances. Appliances using fuzzy or neuro-fuzzy logic and air conditioners with heating and cooling capabilities sold especially well.

Audio Equipment

Matsushita's audio equipment category accounted for 9 percent of the company's revenue, with sales of $4,234 million for the period ended March 31, 1991. Although audio equipment in Japan was generally slow during this fiscal year, compact discs (CDs), radio/cassette recorders, and portable headphone cassette players continued as sales leaders in this segment.

Other products under the audio equipment category are radios, tape recorders, stereo hi-fi and related equipment, car audio products, and electronic musical instruments.

Batteries and Kitchen-Related Products

The batteries and kitchen-related products category accounted for 5 percent of Matsushita's revenue, $2,474 million for the fiscal year 1991. Batteries include compact batteries such as nickel-cadmium batteries. These batteries are used in video camcorders, portable phones, notebook-size personal computers, and other portable electronic products. Lithium batteries are also produced and used in cameras and for office automation equipment memory backups.

Others

The balance of Matsushita's business includes sales of bicycles, cameras and flash units, prerecorded tapes and discs, water purifiers, and imported materials and products such as nonferrous metals, lumber, paper, medical equipment, and cabin cruisers. This category accounted for 10 percent of the company's total revenue for fiscal 1991, with total sales of $4,551 million.

Further Information

For further information on the company's business segments, please contact the appropriate Dataquest industry service.

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Table 1
Four-Year Corporate Highlights (Millions of U.S. Dollars)

	1988*	1989	1990	1991
Four-Year Revenue	36,710.8	42,918.1	41,998.1	46,733.9
Percent Change	NA	16.91	-2.14	11.28
Capital Expenditure	1,679.8	2,537.5	2,482.0	3,377.9
Percent of Revenue	4.58	5.91	5.91	7.23
R&D Expenditure	2,022.7	2,488.1	2,418.5	2,718.6
Percent of Revenue	5.51	5.80	5.76	5.82
Number of Employees	134,186	193,088	198,299	210,848
Revenue ($K)/Employee	273.58	222.27	211.79	221.65
Net Income	1,192.7	1,664.4	1,648.1	1,833.4
Percent Change	NA	39.56	-0.98	11.25
Exchange Rate (U.S.$1=¥)	138.03	128.25	142.93	141.21

1991 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	11,162.8	11,831.9	12,635.8	11,103.5
Quarterly Profit	413.02	486.13	596.03	338.36

NA = Not applicable
*In 1987, Matsushita changed its fiscal year-end from November to March 31. Fiscal 1987 represents only four months from November 1986 to March 31, 1987. Because of these changes, no information is included for 1987.

Source: Matsushita Electric Industrial Co. Ltd. Annual Reports
Dataquest (January 1992)

Table 2
Revenue by Geographic Region (Percent)

Region	1988*	1989	1990	1991
Japan	59	58	56	55
International	41	42	44	45

*In 1987, Matsushita changed its fiscal year-end from November to March 31. Fiscal 1987 represents only four months from November 1986 to March 31, 1987. Because of these changes, no information is included for 1987.

Source: Matsushita Electric Industrial Co. Ltd. Annual Reports
Dataquest (January 1992)

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1991 SALES OFFICE LOCATIONS

North America—9
Europe—15
Asia/Pacific—142
  Japan—132
ROW—12

MANUFACTURING LOCATIONS

North America

America Kotobuki Electronics Industries (United States)
  VCRs
American Matsushita Electronics Corporation (United States)
  Color TV picture tubes
Kyushu Matsushita Electric Corporation of America (United States)
  Deflection yokes
Matsushita Communication Industrial Corporation of America (United States)
  Car telephones, pagers, point-of-sale electronic cash register systems
Matsushita Compressor Corporation of America (United States)
  Air conditioning compressors
Matsushita Computer Company (United States)
  Personal computers, workstations
Matsushita Electronic Components Corporation of America (United States)
  Electrolytic capacitors, car audio speakers, filters, switchers
Matsushita Industrial Canada (Canada)
  Color TVs, speaker boxes, TV cabinets, AV racks
Matsushita Industrial de Baja California S.A. de C.V. (United States)
  TV chassis, color TVs
Matsushita Refrigeration Co. of America (United States)
  Refrigerators
Matsushita Semiconductor Corporation of America (United States)
  Semiconductors
Matsushita-Ultra Tech. Battery Corp. (United States)
  Batteries
Panasonic Technologies (United States)
  R&D

Europe

Kyushu Matsushita Electric (United Kingdom)
  Electronic typewriters, printers
Matsushita Business Machine (Germany)
  Plain paper copiers
Matsushita Communication Deutschland (Germany)
  Car radios/stereos
Matsushita Communication Industrial (United Kingdom)
  Car telephones
Matsushita Electric (United Kingdom)
  Color TVs, microwave ovens
Matsushita Electric Motor (Germany)
  Motors
Matsushita Electronic Components (Germany)
  Electronic parts, materials
Matsushita Electronic Components (United Kingdom)
  Transformers, LC filters
Matsushita Electronic Magnetron Corp. (United Kingdom)
  Magnetrons for microwave ovens
Matsushita Graphic Communication Systems Ltd. (United Kingdom)
  Fax machines
Matsushita Video Manufacturing (Germany)
  VCR mechanisms
MB Video (Germany)
  VCRs, CD players
Panasonic Espana (Spain)
  Electric equipment
Panasonic France S.A. (France)
  Consumer electronics

Asia/Pacific

A.P. National (Thailand)
  Home electrical appliances
Asahi Kogyo (Japan)
  Tape recorders
Beijing-Matsushita Color CRT (China)
  Color CRTs
International Fan Manufacturing (Hong Kong)
  Electric fans
Katano Matsushita (Japan)
  Audio equipment
Kibi Matsushita (Japan)
  Video equipment
Kyushu Matsushita Electric (Japan)
  Data processing, business machines, magnetic heads
Matsue Matsushita Denki (Japan)
  Capacitors
Matsusaka Seimitsu (Japan)
  Assembly of motors
Matsushita Air-Conditioning Corporation (Malaysia)
  Air conditioners

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Matsushita Communication Industrial (Japan)
Data processing, communication, control, video equipment
Matsushita Communication Industrial Corp. of the Philippines (Philippines)
FDDs, ECM
Matsushita Compressor & Motor (Malaysia)
Compressors, fan motors
Matsushita Denshi (Singapore)
IC production, large-scale integration (LSI) design
Matsushita Electric (Australia)
TVs, audio equipment
Matsushita Electric (Malaysia)
Home electrical appliances
Matsushita Electric (Taiwan)
Electrical appliances
Matsushita Electric Institute of Technology (Taiwan)
R&D
Matsushita Electric Works (Japan)
Electrical housing equipment
Matsushita Electronic Components (Japan)
Electronic equipment parts
Matsushita Electronic Components (Malaysia)
Electronic parts
Matsushita Electronic Components (Singapore)
Electronic parts
Matsushita Electronic Motor (Malaysia)
Electronic motors
Matsushita Electronic Motor (Singapore)
Precision motors, applied equipment
Matsushita Electronics (Japan)
Semiconductors, electron tubes, lighting equipment
Matsushita Electronics (Singapore)
Audio equipment
Matsushita Graphic Communication Systems (Japan)
Facsimiles, graphics equipment
Matsushita Graphic Communications Systems (Singapore)
Fax machines
Matsushita Industrial (Malaysia)
Air conditioners, compressors
Matsushita Industrial Equipment (Japan)
Industrial equipment
Matsushita-Kotobuki Electronics (Japan)
Video equipment, TVs, tape recorders
Matsushita Precision Industrial (Malaysia)
Flyback transformers, coils
Matsushita Refrigeration (Japan)
Refrigerators, air conditioners
Matsushita Refrigeration Industries (Malaysia)
Refrigerator/freezers
Matsushita Refrigeration Industries (Singapore)
Compressors
Matsushita Refrigeration Industries (Thailand)
Refrigerator/freezers
Matsushita Research Institute (Japan)
Electronics research
Matsushita Seiko (Japan)
Electric fans, ventilators, air conditioners
Matsushita Seiko Hong Kong International Manufacturing Co. Ltd. (Hong Kong)
Air conditioners
Matsushita Technical Center (Singapore)
Production equipment
Matsushita Television (Malaysia)
Color TVs
Miyazaki Matsushita Denki (Japan)
Ceramics, magnetic materials, resistant materials
National Micromotor (Japan)
Microprecision motors
National Thai (Thailand)
Home electrical appliances
PFU Ltd. (Japan)
Minicomputers
Precision Electronics (Philippines)
Home electrical appliances
P.T. Matsushita Gobel Battery Industry (Indonesia)
Batteries
P.T. National Gobel (Indonesia)
Home electrical appliances
Takefu Matsushita Electric (Japan)
Micromotors
Victor Company of Japan (Japan)
Video/audio equipment, TVs
Wakayama Precision (Japan)
Refrigerators, air conditioners

ROW

Matsushita Electric (East Africa)
Radios, radio cassette recorders, dry batteries
Matsushita Electrica de Guatemala (Guatemala)
Audio equipment
Matsushita Electric de El Salvador (El Salvador)
Audio equipment
Matsushita Industrial de Baja California (Mexico)
Color TV chassis
National Centroamericana
Dry batteries, audio equipment
National Componentes Electronicos do Brazil (Brazil)
Electronic parts
National do Brazil (Brazil)
Matsushita group products
National Electric Cote d'Ivoire (Ivory Coast)
TVs, radio cassette recorders
National Panasonic Fueguina
Color TVs, radio cassette recorders
National Peruana (Peru)
Home electrical appliances
Panasonic de Mexico (Mexico)
Audio equipment, electronic parts
Panasonic Industrial de Venezuela C.A. (Venezuela)
Consumer electronic products

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Springer National Componentes (Brazil)
Assembly of micromotors, CRT sockets, PC boards
Springer National da Amazonia (Brazil)
Color TVs, audio equipment

SUBSIDIARIES

North America

Matsushita Electric Corporation of America (United States)
Solbourne Computer (United States)

Europe

Matsushita Electric (U.K.) Ltd. (United Kingdom)
Matsushita Electronic Magnetron Corp. (United Kingdom)
Matsushita Graphic Communication Systems U.K. Ltd. (United Kingdom)
Panasonic Espana S.A. (Spain)
Panasonic France S.A. (France)

Asia/Pacific

Kyushu Matsushita Electric Co. Ltd. (Japan)
Matsushita Battery Industrial Co. Ltd. (Japan)
Matsushita Communications Industrial Co. Ltd. (Japan)
Matsushita Electric (Taiwan) Co. Ltd. (Taiwan)
Matsushita Electronic Components Co. Ltd. (Japan)
Matsushita Electronics Corporation (Japan)
Matsushita Electronics (S) Pte. Ltd. (Singapore)
Matsushita Graphic Communications Systems Inc. (Japan)
Matsushita Housing Products Co. Ltd. (Japan)
Matsushita Industrial Equipment Co. Ltd. (Japan)
Matsushita Industrial Corporation Sdn. Bhd. (Malaysia)
Matsushita Kotobuki Electronics Industries Ltd. (Japan)
Matsushita Refrigeration Company (Japan)
Matsushita Refrigeration Industries (S) Pte. Ltd. (Singapore)
Matsushita Seiko Co. Ltd. (Japan)
Victor Company of Japan Ltd. (Japan)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Digital Tape Licensing
Matsushita will share its digital compact cassette tape technology, which was jointly developed with Philips, with third parties. The aim is to make the digital tape format, which competes against digital audio tape, a standard in the industry.

Tandy Corporation
Tandy Corporation and Matsushita have signed a joint venture to manufacture laptop and notebook computers. Both companies will be equal partners and share in the technology of the new company called PTCC Inc.

Texas Instruments Inc. (TI)
TI and Matsushita signed a cross-licensing agreement. This five-year agreement replaced the previous agreement that expired in 1990. TI will continue to receive royalty payments from Matsushita based on worldwide sales of chips by the two Japanese firms.

Energy Conversion Devices Co. (ECD)
ECD and Matsushita have signed a patent licensing agreement for ECD's patented phase transformation optical disk system. With this agreement Matsushita will be able to sell optical disks worldwide.

Siemens Nixdorf Information Systems (SNI)
SNI and Matsushita have signed an agreement to develop PC peripherals. The development will include an expansion unit for 16-bit and 32-bit notebook-size PCs. The unit will contain extra memory and space for an additional battery unit. Matsushita will produce the expansion unit. The company will market it in Europe and will also supply the device to SNI on an OEM basis.

Sun Microsystems Inc.
Sun Microsystems Inc. has signed an agreement with Matsushita, Fujitsu, and Toshiba whereby Sun will exchange information with the other firms on image-processing techniques for multimedia workstations.

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1990

The Santa Cruz Operation
The Santa Cruz Operation and Matsushita have signed an agreement to codevelop a Japanese version of a UNIX operating system. Matsushita will manufacture the new product on an OEM basis, while The Santa Cruz Operation will be responsible for marketing efforts through a new branch office to be established in Japan.

SNI
SNI and Matsushita signed an agreement to have SNI supply desktop PCs to Matsushita. In return, Matsushita will supply laptop PCs to SNI on an OEM basis.

1989

Signetics Company
Signetics and Matsushita entered a sales agency agreement for memory products.

Weitek Corporation
Weitek and Matsushita are jointly developing a microprocessor product.

Siemens
Matsushita and Siemens formed a joint venture for producing passive electronic components.

Office Workstations Ltd.
Matsushita and Office Workstations of Scotland formed a joint venture for development of office automation software products.

1988

Hewlett-Packard Company, IBM Corporation, Intel
Matsushita agreed to supply these companies with a total of more than 1 million 1Mb DRAMs per month.

Intel Corporation
Matsushita agreed to subcontract production of Intel's 8-bit microcontrollers for the Japanese market. The companies also agreed to jointly develop a sub-0.5-micron 16Mb DRAM process.

Sun Microsystems
The SPARC RISC chip was licensed for use in workstations being developed by Solbourne Computer, a Matsushita subsidiary.

Tosoh
The companies agreed to jointly develop conductive electron-beam resist that completely solves the electrification problem occurring with direct-write e-beams.

Motorola
Matsushita agreed to purchase Motorola semiconductors for use in videocassette recorders.

1987

NEC Corporation
NEC and Matsushita agreed to develop the next generation of steppers for very large scale integration (VLSI) manufacturing.

SAE Inc.
SAE and Matsushita agreed to jointly develop a 64-bit microprocessor with plans for a 64-bit engineering workstation in 1989.

Philips
Philips and Matsushita renewed a business cooperation agreement for the next ten years in which Matsushita Electric will continue to own 65 percent of Matsushita Electronics and Philips will own 35 percent. Matsushita agreed to supply LSIs for compact discs to Philips, and the companies made a second-source agreement for 8-bit CMOS microcontrollers.

Intel
Matsushita obtained a license from Intel for the 8051 and three other 8-bit microcontrollers.

TRW
The companies agreed to jointly develop a 0.8-micron-wavelength GaAlAs semiconductor laser for space communications.

Nikon Corporation
The companies jointly developed advanced i-line steppers and excimer lasers for next-generation VLSIs.

MERGERS AND ACQUISITIONS

1991

Matsushita made no mergers or acquisitions in 1991.

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1990

MCA Inc.
MCA Inc. was acquired by Matsushita for approximately $6.1 billion. MCA is primarily engaged in the production and distribution of motion pictures and musical recordings, theme parks, book publishing, retailing, and real estate development.

1989

Matsushita made no mergers or acquisitions in 1989.

1988

Matsushita Electric Trading Co. Ltd. (MET)
MET, a 51.24 percent owned consolidated subsidiary, was merged into the company in exchange for 73.4 million shares of Matsushita common stock having a fair market value of $1.1 billion.

KEY OFFICERS

Masaharu Matsushita
Chairman of the board

Akio Tanii
President

Shoji Sakuma
Executive vice president

Masahiko Hirata
Executive vice president

Keiya Toyonaga
Senior managing director

Hiroyuki Mizuno
Senior managing director

Tsuzo Murase
Senior managing director

PRINCIPAL INVESTORS

Sumitomo Bank—4.4 percent
Sumitomo Life Insurance—4.4 percent
Nippon Life Insurance—4.0 percent
Matsushita Investment and Development—3.2 percent
Mitsubishi Trust—3.0 percent
Sumitomo Trust—2.9 percent
Konosuke Matsushita—2.6 percent
Toyo Trust—2.0 percent
Kyowa Bank—2.0 percent

FOUNDERS

Konosuke Matsushita

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Table 3
Balance Sheet
Fiscal Year Ending March 31
(Millions of U.S. Dollars)

Balance Sheet	1988*	1989	1990	1991
Cash	10,016.4	11,229.2	14,068.8	11,737.8
Receivables	4,915.5	6,137.8	7,782.4	9,062.4
Marketable Securities	2,562.6	1,652.8	2,346.6	1,294.5
Inventory	4,857.9	6,210.6	5,919.0	6,593.7
Other Current Assets	1,967.2	2,303.0	2,157.4	2,491.3
Total Current Assets	24,319.6	27,533.4	32,274.3	31,179.8
Net Property, Plants	5,056.0	6,426.6	6,700.1	8,202.7
Investments	8,971.7	11,828.3	11,527.1	17,420.9
Other Assets	3,149.8	4,128.9	4,429.0	5,239.7
Total Assets	41,497.2	49,917.3	54,930.5	62,043.1
Total Current Liabilities	13,359.1	16,717.6	18,208.2	22,500.5
Long-Term Debt	4,093.6	4,849.1	8,375.3	8,665.8
Other Liabilities	6,005.4	5,999.5	5,952.1	6,553.4
Total Liabilities	23,458.1	27,566.3	32,535.6	37,719.7
Common Stock	1,048.2	1,280.7	1,293.9	1,383.0
Other Equity	1,815.8	3,266.7	3,700.2	3,688.8
Retained Earnings	15,175.1	17,803.6	17,400.8	19,251.5
Total Shareholders' Equity	18,039.1	22,351.0	22,394.9	24,323.3
Total Liabilities and Shareholders' Equity	41,497.2	49,917.3	54,930.5	62,043.1
Exchange Rate (U.S.$1=¥)	138.03	128.25	142.93	141.21

*In 1987, Matsushita changed its fiscal year-end from November to March 31. Fiscal 1987 represents only four months from November 1986 to March 31, 1987. Because of these changes, no information is included for 1987.

Source: Matsushita Electric Industrial Co. Inc. Annual Reports
Dataquest (January 1992)

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Table 4
Consolidated Income Statement
Fiscal Year Ending March 31
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1988*	1989	1990	1991
Revenue	36,710.8	42,918.1	41,998.1	46,733.9
Cost of Sales	24,223.1	28,622.9	28,052.8	31,113.2
R&D Expense	2,022.7	2,488.1	2,418.5	2,718.6
SG&A Expense	9,880.5	11,042.3	10,777.8	12,273.9
Capital Expense	1,679.8	2,537.5	2,482.0	3,377.9
Pretax Income	3,283.6	4,128.2	4,000.1	4,230.6
Pretax Margin (%)	8.94	9.62	9.52	9.05
Effective Tax Rate (%)	55.50	54.20	52.60	51.10
Net Income	1,192.7	1,664.4	1,648.1	1,833.4
Shares Outstanding, Millions	1,861.8	1,955.6	2,080.2	2,093.4
Per Share Data				
Earnings	0.67	0.76	0.68	0.83
Dividend	0.80	0.90	0.63	0.89
Book Value	9.69	11.43	10.77	11.62
Exchange Rate (U.S.$1=¥)	138.03	128.25	142.93	141.21

*In 1987, Matsushita changed its fiscal year-end from November to March 31. Fiscal 1987 represents only four months from November 1986 to March 31, 1987. Because of these changes, no information is included for 1987.

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Table 5
Balance Sheet
Fiscal Year Ending March 31
(Billions of Yen)

Balance Sheet	1988*	1989	1990	1991
Cash	1,382.6	1,440.1	2,010.8	1,657.5
Receivables	678.5	787.2	1,112.3	1,279.7
Marketable Securities	353.7	212.0	335.4	182.8
Inventory	670.5	796.5	846.0	931.1
Other Current Assets	271.5	295.4	308.4	351.8
Total Current Assets	3,356.8	3,531.2	4,612.9	4,402.9
Net Property, Plants	697.9	824.2	957.6	1,158.3
Investments	1,238.4	1,516.9	1,647.6	2,460.0
Other Assets	434.8	529.6	633.0	739.9
Total Assets	5,727.9	6,401.9	7,851.1	8,761.1
Total Current Liabilities	1,843.9	2,144.0	2,602.5	3,177.3
Long-Term Debt	565.0	621.9	1,197.1	1,223.7
Other Liabilities	828.9	769.4	850.7	925.4
Total Liabilities	3,237.8	3,535.3	4,650.3	5,326.4
Common Stock	144.7	164.3	184.9	195.3
Other Equity	250.7	419.0	528.9	520.9
Retained Earnings	2,094.7	2,283.3	2,487.1	2,718.5
Total Shareholders' Equity	2,490.1	2,866.6	3,200.9	3,434.7
Total Liabilities and Shareholders' Equity	5,727.9	6,401.9	7,851.2	8,761.1
Exchange Rate (U.S.$1=¥)	138.03	128.25	142.93	141.21

*In 1987, Matsushita changed its fiscal year-end from November to March 31. Fiscal 1987 represents only four months from November 1986 to March 31, 1987. Because of these changes, no information is included for 1987.

Source: Matsushita Electric Industrial Co. Ltd. Annual Reports
Dataquest (January 1992)

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Table 6
Consolidated Income Statement
Fiscal Year Ending March 31
(Billions of Yen, except Per Share Data)

Income Statement	1988*	1989	1990	1991
Revenue	5,067.2	5,504.3	6,002.8	6,599.3
Cost of Sales	3,343.5	3,670.9	4,009.6	4,393.5
R&D Expense	279.2	319.1	345.7	383.9
SG&A Expense	1,363.8	1,416.2	1,540.5	1,733.2
Capital Expense	231.9	325.4	354.8	477.0
Pretax Income	453.2	529.4	571.7	597.4
Pretax Margin (%)	8.94	9.62	9.52	9.05
Effective Tax Rate (%)	55.50	54.20	52.60	51.10
Net Income	164.6	213.5	235.6	258.9
Shares Outstanding, Millions	1,861.8	1,955.6	2,080.2	2,093.4
Per Share Data				
Earnings	80.34	99.94	108.34	117.12
Dividend	9.52	11.90	10.00	12.50
Book Value	1.34	1.47	1.54	1.64
Exchange Rate (U.S.$1=¥)	138.03	128.25	142.93	141.21

*In 1987, Matsushita changed its fiscal year-end from November to March 31. Fiscal 1987 represents only four months from November 1986 to March 31, 1987. Because of these changes, no information is included for 1987.

Source: Matsushita Electric Industrial Co. Ltd. Annual Reports
Dataquest (January 1992)

Table 7
Key Financial Ratios
Fiscal Year Ending March 31

Key Financial Ratios	1988*	1989	1990	1991
Liquidity				
Current (Times)	1.82	1.65	1.77	1.39
Fixed Assets/Equity (%)	230.03	223.33	245.28	255.08
Current Liabilities/Equity (%)	74.05	74.79	81.31	92.51
Total Liabilities/Equity (%)	130.03	123.33	145.28	155.08
Profitability (%)				
Return on Assets	2.87	3.33	3.00	2.96
Return on Equity	6.61	7.45	7.36	7.54
Profit Margin	3.25	3.88	3.92	3.92
Other Key Ratios				
R&D Spending % of Revenue	5.51	5.80	5.76	5.82
Capital Spending % of Revenue	4.58	5.91	5.91	7.23
Employees	134,186	193,088	198,299	210,848
Revenue (¥M)/Employee	37.76	28.51	30.27	31.30
Capital Spending % of Assets	4.05	5.08	4.52	5.44
Exchange Rate (U.S.$1=¥)	138.03	128.25	142.93	141.21

*In 1987, Matsushita changed its fiscal year-end from November to March 31. Fiscal 1987 represents only four months from November 1986 to March 31, 1987. Because of these changes, no information is included for 1987.

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Motorola Incorporated

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Schaumberg, Illinois 60196
Telephone: (708) 576-5000
Fax: (708) 576-7653
Dun's Number: 00-132-5463

Date Founded: 1928

CORPORATE STRATEGIC DIRECTION

Motorola Incorporated is one of the world's leading suppliers of electronic equipment, systems, components, and services. Applications range from the telecommunications market to the semiconductors market, with products including two-way radios, pagers, cellular telephones and systems, semiconductors, defense and aerospace electronics equipment, automotive and industrial electronics equipment, computers, data communications equipment, and information processing and handling equipment. Founded in 1928 for the purpose of manufacturing automobile radios, Motorola has grown from a radio equipment and communications manufacturer to a $10.9 billion* Fortune 100 company with operations in diverse electronics markets.

Motorola entered the semiconductor industry early in its history in 1948, when semiconductor operations were established to develop automobile radio applications. Today, Motorola maintains one of the broadest product lines of all semiconductor manufacturers and offers electronics products in other sectors as well. Motorola is the largest semiconductor producer based in the United States.

Motorola divides its operations into eight main groups: Land Mobile Products, Paging and Telepoint Systems, Semiconductor Products, General Systems Products, Information Systems Products, Government Electronics Products, and the Automotive and Industrial Electronics groups. The Communications Products segment, which includes the Land Mobile Products and Paging and Telepoint Systems groups, remains the largest segment in terms of net sales, bringing in $3.6 billion and accounting for 32.7 percent of revenue in fiscal 1990. The Semiconductor Products group continues to close the gap with the Communications Products segment, bringing in $3.4 billion in revenue in 1990, accounting for 31.5 percent of revenue. The General Systems Products group represented the highest rate of growth in 1990, as the group's revenue increased 39.2 percent to $2.6 billion in sales. General Systems has increased 140.3 percent in the last two years, up from the 1988 net sales total of $1.1 billion.

Motorola's total revenue increased 13.1 percent to $10.9 billion in fiscal 1990 from $9.6 billion in fiscal 1989. Net income increased 0.2 percent to $499.0 million in fiscal 1990 from $498.0 million in fiscal 1989. Motorola employs approximately 115,400 people worldwide.

The international market continues to increase its impact on Motorola's total revenue figures. In fiscal 1985, international sales accounted for 25 percent of revenue, while in fiscal 1990 the figure had increased to 44 percent of total revenue. Over the last two years, international sales revenue has increased 48.6 percent, nearly doubling the domestic growth of 24.8 percent. Motorola expects this international growth trend to continue in fiscal 1991, with the main growth coming from Asia and Europe.

Accordingly, Motorola has continued to expand its operations on a global scale. In 1990, international highlights included the opening of a new semiconductor facility in Hong Kong, the provision of the radio system for the Asian games in China, and the cementing of plans to supply the communications system for the Channel Tunnel that will link England and France. The company also began operations in the emerging eastern Europe markets, selling two-way radios in Romania and Yugoslavia and cellular telephones in Hungary.

*All dollar amounts are in U.S. dollars.

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Research and development expenditure totaled $1.0 billion in fiscal 1990, representing 9.3 percent of revenue. Capital spending expenditure totaled $1.3 billion in fiscal 1990, representing 12 percent of revenue.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Table 3, a comprehensive financial statement, is at the end of this backgrounder.

BUSINESS SEGMENT STRATEGIC DIRECTION

Communications Products

The Communications Products segment accounted for 32.7 percent of Motorola's 1990 net sales, bringing in $3.6 billion in factory revenue. This group produces a wide variety of radio communications equipment, including base stations, digital voice communications systems, high-frequency single-banded radio systems, mobile/portable data communications, FM two-way radio communications systems, and radio paging systems. Motorola can claim the distinction of being the first foreign supplier to join Japanese competitors in selling to Japan's national telephone company, Nippon Telegraph and Telephone Company. Motorola is a market leader in radio paging equipment.

The group's 1990 revenue of $3.6 billion represented a 7.6 percent increase over 1989's revenue of $3.3 billion. Operating profits decreased 25.5 percent to $225 million in 1990, down from $302 million in 1989. Motorola attributes this decline to increased research and development costs in the areas of radio frequency (RF) communications and radio data communications, expenses associated with expansion of international distribution, changes in domestic distribution, and shortfalls in implementation and efficiency in certain areas of business. At the end of fiscal 1990, the Communications Products sector was divided into two divisions: the Land Mobile Products group and the Paging and Telepoint Systems Group.

Land Mobile Products

Nineteen-ninety was an active year for the Land Mobile Products sector, as Motorola continued to invest heavily in future technologies. Using this newly formed sector, the company is active in the development of Specialized Mobile Radio (SMR) systems, wireless data communications, and digital trunking.

Motorola took major steps toward the completion of its Coverage Plus SMR system, a nationwide voice and data communications and vehicle location network currently being implemented in the United States. The system enables dispatchers to locate and communicate directly with vehicles anywhere on the network either by voice or data messages. Over 500 sites have been installed to date in the United States. The company also implemented SMR systems in China and Germany.

Motorola introduced a number of new models of trunked radio system products in 1990. The JSMR-II, the company's first 1.5-GHz shared trunked radio system, was installed in Japan. The system features newly developed repeaters and subscriber radios in the new frequency band. Motorola also began distribution of the company's first 1.5-GHz mobile radio, the MG-100, and the MIB-5000, an 800-MHz system that boasts the world's smallest trunked mobile radio.

Motorola continued production of the ARDIS radio data communications system, a result of a joint venture with IBM. The system provides communications networking applications in the areas of field service, insurance claims, and public safety and transportation. The company also introduced two modems that are compatible with networks such as ARDIS—the RPM 840 integrated portable radio data modem and the RPM 400i modem for laptop and other hand-held computers.

Paging and Telepoint Systems

Motorola introduced a number of new products in 1990 under the auspices of the Paging and Telepoint Systems group. The introduction of the CT-2 cordless telephone marked Motorola's entrance into the second-generation digital cordless telephone market. The CT-2 technology provides cordless technology that allows the personal cordless telephones to be utilized in the home or office through conventional methods. The technology also allows use of the CT-2 telephones outside the home and office through the use of base stations known as telepoints, providing limited-range access. The CT-2 system was especially

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popular in the international markets, as Motorola received substantial orders for the CT-2 from Singapore Telecom and other companies in Malaysia, Thailand, and Hong Kong.

Motorola offers a diverse line of pagers and is a market leader in radio paging equipment. In 1990, the company introduced the Advisor pager, an alphanumeric unit with a four-line display and up to 32,000 characters of memory. Full production of the revolutionary Wristwatch pager began in the fourth quarter of 1990. The Wristwatch pager, the result of a joint venture with Timex, combines a numeric display pager with a digital watch and is compatible with existing paging systems throughout the world.

Semiconductor Products

In an era of increasing specialization and niche market-oriented companies, Motorola represents an unusual breed of U.S. semiconductor manufacturers. As the largest U.S. chipmaker, Motorola continues to be one of the few remaining broad-based semiconductor suppliers in the nation. The company considers its wide product breadth to be critical to its semiconductor strategy and has charted a course that provides an extensive product portfolio.

The company's semiconductor revenue in 1990 was $3.43 billion, an increase of 13.1 percent over 1989. The semiconductor products segment accounted for 31.5 percent of total sales for fiscal 1990. According to Dataquest, Motorola possessed 6.3 percent of the 1990 worldwide semiconductor market, ranking it fourth among more than 140 vendors. The company ranks first in the North American semiconductor market with 11.3 percent market share and $2.0 billion in factory revenue. A review of Motorola's product portfolio shows that the company is manifestly strong in the areas of discrete devices and analog, logic, and microcomponent products. It is investing to establish a stronger position in memory through the development of a competitive fast SRAM offering, as well as a strategic position in DRAMs under a technology agreement with Toshiba.

Discrete Devices

Although many semiconductor producers had abandoned discrete products for integrated circuits, Motorola remains an important force in discretes such as transistors, diodes, and thyristors. In a market dominated by Japanese companies, Motorola had been the leading supplier and was dislodged from the number one position only in 1987 by Toshiba. Motorola held onto the number two position in 1990 with 9.8 percent of the worldwide market share, with discrete revenue amounting to $808 million.

Serving the broad range of discrete markets also requires a broad range of capabilities, including advanced submicron technology for such products as RF semiconductors, power MOS and small-signal devices, and leading-edge manufacturing and packaging technologies for mature, high-volume semiconductors. These new technologies often combine discrete and integrated circuit technologies to provide new products containing substantial added value. The company also offers a broad range of silicon pressure sensing devices including a new fully signal-conditioned integrated pressure sensor.

Optoelectronics

Motorola's optoelectronic products include emitter/detectors, optocouplers, optointerrupters, and fiber-optic switches and components. However, with revenue of $26 million during fiscal 1990, Motorola is a small player in the $2.7 billion optoelectronics market. Dataquest found Motorola to rank nineteenth in the worldwide optoelectronics market during 1990.

Analog

Motorola's growing portfolio of analog circuits is targeted primarily toward automotive, telecommunications, and consumer applications. Using bipolar and CMOS technologies, Motorola has developed a variety of proprietary and custom devices. In 1990, Motorola held a 4.6 percent market share and ranked sixth in the worldwide analog market, according to Dataquest.

Logic

Motorola offers a variety of logic products in standard logic, gate arrays, and custom products. The company has long been a leading producer of standard logic circuits, producing a variety of products in TTL, ECL, and CMOS technologies. In the standard logic arena, Motorola is a major market participant, ranking fourth in the bipolar and digital logic markets and third in the MOS logic market during 1990, according to Dataquest.

Application-Specific ICs (ASICs)

In addition to working closely with key customers to offer high-performance system solutions in both bipolar and CMOS technologies, Motorola drives the industry standards for computer-aided design (CAD) actively in order to accelerate the availability and

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utility of open architecture alternatives. These activities are key features of the company's strategy in the ASIC markets.

During 1989, Motorola introduced a new design concept for ASICs called Customer-Defined Arrays. Customer-Defined Arrays combine array- and cell-based chip architectures with multiple process technologies on a single circuit. Motorola's new Open Architecture CAD System gives customers a complete ASIC development environment using industry-standard workstations and leading third-party design and verification tools.

Motorola is the leading supplier of ECL gate arrays to the merchant market. Motorola's MCA III process supports 2,200- and 10,000-gate ECL arrays featuring 120ps typical gate delays and 1,200- to 1,500-MHz input frequencies. In 1990, Motorola extended the line by introducing an ETL series providing mixed ECL, TTL, and pseudo-ECL interfaces in 750-, 3,200-, and 6,200-gate densities. System clock speeds up to 2,500 MHz are supported. Motorola also offers bipolar foundry services based on the MCA V process with four-layer metal and 0.8-micron emitters. Typical gate delays of 80ps are achieved in a channelless architecture. Next-generation bipolar arrays will shrink emitter width and include a BiCMOS process option for high-speed embedded memory. Initial products will allow 20,000 to 30,000 gates of 50ps logic combined with 256,000 bits of BiCMOS RAM.

In the arena of CMOS process technology, Motorola has a family of high-density CMOS gate arrays manufactured in a submicron process. The H4C Series utilizes a sea-of-gates architecture and ranges in gate count from approximately 27,000 to 318,000 gates. Utilizing triple layer metal routing, the H4C Series combines user-configurable RAMs up to 256Kb, digital phase-locked loops, and low power consumption for true systems integration.

Microcomponents

Motorola is a leading participant in the microcomponents market. The company has been a long-time supplier of proprietary microprocessors, microcontrollers, and microperipherals to this market. With estimated revenue of $1.0 billion in an approximately $10.1 billion market, a 10.0 percent market share, Motorola ranks as the third-largest microcomponent manufacturer in the world. Motorola has ranked consistently as the number three supplier to this market, behind Intel and NEC. According to Dataquest, Motorola closed the gap with second-place NEC in 1990, pulling to within $74 million in yearly revenue.

Motorola is the leading supplier of 8-bit microcontrollers in terms of units shipped, garnering a 23.9 percent share of the worldwide market. The company's 68HC05 continues to be the top microcontroller on the market in terms of unit shipments, with over 73.6 million units shipped in 1990. A leading application for these 8-bit MCUs is in the automotive industry.

The company introduced its first 16-bit microcontroller, the MC68HC16, in 1990. The MC68HC16 features on-chip control-oriented digital signal processing (DSP) capability, with planned applications including future vehicles from Chrysler Corporation.

Motorola also unveiled the 68332, a 32-bit embedded microcontroller. It is based on Motorola's 68020 central processing unit and has been chosen by General Motors for control functions in future vehicles. The 68302 Integrated Multiprotocol Processor was developed for communications applications. In addition, the company introduced the 68HC16 microcontroller family, its first 16-bit MCU device, to provide a smooth migration path from 8-bit to 32-bit microcontroller applications.

The company is also prominent in high-end microprocessors, where it has a full line of products including high-performance floating-point coprocessors and DSP support. Motorola ranked second in the 32-bit microprocessor market with a 30.5 percent market share in 1990, according to Dataquest estimates. Motorola had the advantage of a head start in the emerging 32-bit microprocessor market with its 68020 and 68030 devices. Because the M68000 microprocessor, a 16-bit microprocessor introduced in 1979, had a 32-bit internal architecture, Motorola was able to upgrade 16-bit data bus paths to a full 32-bit architecture with the 68020 a full two years before its competitors.

In early 1987, Motorola produced silicon for the 68030, a second-generation 32-bit microprocessor that incorporated such functions as a paged MMU, an instruction cache, and a data cache with burst-fillable mode in a Harvard-style architecture. These devices have found usage in a variety of applications, including business systems, artificial intelligence platforms, robotics, telecommunications, multiprocessor systems, military products, and most prominently in technical workstations.

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In the fourth quarter of 1990, Motorola began full-scale production of its next-generation complex-instruction-set computing (CISC) microprocessor, the MC68040. With 1.2 million transistors, the MC68040 delivers 20 mips and a sustained rate of 3.5 mflops at 25 MHz. Fabricated with Motorola's 0.8-micron high-performance HCMOS process, the MC68040 features an integer unit, a floating-point unit, two memory-management units, and two 4KB cache memories (one for data and one for instructions). It is compatible with the software base of the M68000 family. It has been endorsed as a platform for future products by customers including Apple Computer Inc., Bull, Commodore, Hewlett-Packard/Apollo, NeXT, Nixdorf, and Unisys.

Motorola's 88000 reduced-instruction-set computing (RISC) family of 32-bit microprocessors, first introduced in 1988, has been endorsed by more than 50 computer and telecommunications systems manufacturers, with more than 20 systems already announced. More than 1,500 software packages are under development for the 88000, using its applications software compatibility standard. The company plans to release its second-generation RISC engine, the 88110, during fiscal 1991. Based on Symmetric Superscaler technology, the 88110 will permit instructions to be executed simultaneously and will also eliminate instruction-sensitive performance degradation found in competing RISC processors.

As a part of a proposed three-way technology alliance among Apple, IBM Corporation, and Motorola, the companies announced in July 1991 that Motorola will codesign and manufacture a single-chip implementation of IBM's RS/6000 Power Architecture to be called Power PC. The new RISC chip will be the hardware base of a new entry-level software product to be developed and marketed by Apple and IBM. It will also be the base hardware for future Apple Macintosh computers. This chip will become the third high-performance processor platform in Motorola's portfolio, joining the 68000 and 88000 families.

In 1989, the CPUAX, the new superchip containing 4 million transistors, was designed by TRW and fabricated by Motorola under the U.S. Department of Defense Very High Speed Integrated Circuits (VHSIC) Phase 2 program. This 0.5-micron device can perform 200 mflops and can automatically configure and repair itself. Originally intended by TRW for defense and space applications, the processing knowledge will be used by Motorola in future commercial products.

In digital signal processing, Motorola has introduced its 96002 Media Engine, a 32-bit IEEE floating-point processor. Based on the same architecture as the company's 24-bit fixed-point device, the 96002 is able to create vivid color graphics while generating stereo sound.

Memories

Motorola manufactures a variety of DRAMs and fast SRAMs using CMOS and BiCMOS technologies. The company has developed a strategic supply position in DRAMs as a part of its technology agreement with Toshiba. Motorola is producing 1Mb DRAMs in two of its own fabrication facilities and in its joint venture with Toshiba in Sendai, Japan. A variety of microcomponents also are produced at ths site.

According to Dataquest estimates, Motorola climbed to 9th in the worldwide MOS memory market with a market share of 3.0 percent in 1990, up from a 12th-place ranking and a 2.5 percent market share in 1989.

General Systems Products

The General Systems sector includes the Motorola Cellular group and the Motorola Computer Systems group, formerly called Four-Phase Systems before its acquisition by Motorola in 1982. The General Systems sector was the fastest-growing sector for Motorola in fiscal 1990, with sales increasing 39.2 percent to $2.6 billion. The sector accounted for 24.3 percent of Motorola's total revenue in fiscal 1990, up from the 19.8 percent that the sector's revenue accounted for in 1989.

The Cellular group produces mobile and portable subscriber products and telephone systems, conventional car telephone systems, electronic mobile exchanges, IMTS car telephones, and low-density cellular base stations. As a leader in the fast-growing cellular telephone industry, Motorola is one of the top suppliers of cellular telephone systems as well as mobile and portable phones. Motorola is the market leader in cellular telephones, garnering a 15.2 percent market share with $400 million in revenue in 1990. More than half of the company's cellular revenue comes from outside the United States. Motorola believes that in many underdeveloped countries with limited wireline systems, cellular radiotelephones may become the principal telecommunications system.

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The MicroTAC personal telephone, introduced in 1989, continues to grow in popularity. One of the smallest and lightest cellular telephones currently on the market, the MicroTAC is the size of a checkbook and fits into a pocket or purse while offering the same power, features, and performance as larger cellular phones. The MicroTAC won Japan's 1990 foreign product design award from the Ministry of International Trade and Industry. Motorola is currently testing a new cellular call handling system, the Narrow Band AMPS, which has the potential to multiply cellular system capacity more than threefold using existing cellular standards.

The Computer Systems group develops, manufactures, markets, and services multiuser, supermicroclass computers and board-level products. The group's products are based on industry standards, such as the VMEbus hardware standard, the UNIX operating system, and industry-standard peripheral interfaces. Computer products are marketed to end-user customers, OEMs, VARs, and distributors worldwide. Motorola's 68000 microprocessors and the 88000 series RISC microprocessors are at the core of the VME board-level products.

In 1990, the MultiPersonal Computer was introduced by the Computer Systems group. Based on the 88000 RISC microprocessor, AT&T's UNIX operating system, and the X Window graphics standard developed by Massachusetts Institute of Technology, the MultiPersonal Computer is designed to integrate the commercial desktop computer into the office environment. Features include the MultiPersonal Image Exchange, which allows users to send and receive facsimile documents on-line and route them to the proper user. Also in 1990, Motorola began full-scale production of the MVME165, a VME processor module built around the company's 68040 microprocessor. The MVME165 is designed for embedded control and distributed real-time applications.

Information Systems Products

The Information Systems Products segment accounted for 5.5 percent, or $599 million, of Motorola's total revenue for fiscal 1990. The products are designed and manufactured by Codex Corporation and Universal Data Systems Inc. (UDS).

Codex manufactures and sells high-speed leased-line and dial modems; data/voice, time division, and statistical multiplexers; network management and control systems; X.25 networking equipment; and LAN interconnection products. These products are offered alone and, increasingly, in systems, which have been configured to transmit information between dispersed business machines, terminals, and other peripheral devices, and host computers. Codex also sells communications products that it does not manufacture.

Codex was active in 1990 with the addition of a host of new products. The Codex 3600 Communications platform is a new proprietary communications platform that can be configured as a 24,000-bps modem or a digital transmission device, offering customers increased flexibility. The platform is complemented by two new releases: the 3500 Digital Service Unit/Channel Service Unit and a terminal adaptor for the Integrated Services Digital Network (ISDN). Release 3 of the Codex 9800 Network Management System offers an operational Interface kit that allows the integration of non-Codex products. Interfaces were also released for the "supermanagers" offered by AT&T, Digital Equipment Corporation, and IBM.

UDS manufactures and sells data communications modems, multiplexers, digital data systems (DDS) service units, and ISDN equipment. UDS' 9,600-bps V.32 modems, introduced in 1989, continued to gain popularity in 1990 as shipments more than doubled. The V.32 modems, which are of the plug-in variety and support the IBM PS/2 computer family, won international support with major orders coming from Japan, Germany, and Egypt.

Government Electronics Products

The Government Electronics group is engaged in the design, development, and production of electronic systems and products. During fiscal 1990, it accounted for 6.3 percent of Motorola's total revenue. The group produces diversified military and space electronics equipment, including aerospace telecommunications systems, military communications equipment, radar systems, data links, display systems, positioning and navigation systems, instrumentation products, countermeasures systems, missile guidance equipment, electronic ordnance devices, and drone electronic systems. According to Dataquest, Motorola ranked second in the worldwide military/aerospace semiconductor market in 1990, garnering a 6.7 percent market share.

Major contracts awarded in 1990 included a $78.5 million contract for the FMU-139 fuze and a $36.9 million contract for the MK45 target-detecting device used on the Standard missile. A new product introduced in 1990 was the latest model of the Lightweight Satellite Terminal system, the LST-5C. The

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LST-5C radio weighs only 8.5 pounds and provides full power to establish and maintain a worldwide satellite communications link with only the use of a lithium battery.

Automotive and Industrial Electronics

The Automotive and Industrial Electronics group manufactures and markets solid-state electronic ignition systems, engine management controls, sensors, automotive instruments, and other automotive electronic products. These products are sold to OEMs, including foreign and domestic automobile manufacturers, heavy vehicle manufacturers, and farm equipment manufacturers. In 1990, the group began production of new programs in passenger car and light vehicle applications with Chrysler/Jeep and Ford Motor Company. The group also started shipping diesel engine control models to Cummins Engine Co. and Vehicle Management and Control (V-MAC) modules to Mack Trucks Inc.

Further Information

For further information about Motorola's business segments, please contact the appropriate Dataquest industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	5,888.0	6,727.0	8,250.0	9,620.0	10,885.0
Percent Change	8.18	14.25	22.64	16.61	13.15
Capital Expenditure	567.0	658.0	899.0	1,094.0	1,256.0
Percent of Revenue	9.63	9.78	10.58	11.37	11.54
R&D Expenditure	481.0	524.0	665.0	810.0	1,008.0
Percent of Revenue	8.17	7.79	8.06	8.42	9.26
Number of Employees	94,400	97,700	102,000	104,000	115,400
Revenue ($K)/Employee	62.37	68.85	80.88	92.50	94.32
Net Income	194.0	308.0	445.0	498.0	499.0
Percent Change	169.44	58.76	44.48	11.91	0.20

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	2,533.0	2,715.0	2,703.0	2,934.0
Quarterly Profit	127.0	161.0	102.0	1,095.0

Source: Motorola Incorporated
Annual Reports
Dataquest (October 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
North America	71.31	67.94	63.85	59.65	55.70
International	28.69	32.06	36.15	40.35	44.30

Source: Motorola Incorporated
Annual Reports

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1990 SALES OFFICE LOCATIONS

North America—209
Europe—21
Japan—4
ROW—26

MANUFACTURING LOCATIONS

North America

Albuquerque, New Mexico
Communications products
Arlington Heights, Illinois
Cellular telephone products
Austin, Texas
CMOS logic, MOS digital/analog, ASICs, MCUs, FSRAMs, complex MPUs
Boynton Beach, Florida
Communications products
Carlisle, Pennsylvania
Communications products
Chandler, Arizona
Semiconductor products
Cupertino, California
General information system products
Elma, New York
Automotive electronics products
Fort Worth, Texas
Communications products
Huntsville, Alabama
Modems
Lawndale, California
Semiconductor products
Mansfield, Massachusetts
Data communications products
Mesa, Arizona
MPUs, ASICs, DRAMs, MOS digital/analog, telecom, regulators, op amps, automotive bipolar logic, gate arrays, logic
Mt. Pleasant, Iowa
Communications products
Northbrook, Illinois
Automotive electronics products
Phoenix, Arizona
Power products, RF power products, small-signal sensors, thyristors, TMOS power, Zener diodes, rectifiers
Plantation, Florida
Communications products
Schaumberg, Illinois
Communications products
Seguin, Texas
Automotive electronics products
Tempe, Arizona
Semiconductor products, general information system products
Vega Baja, Puerto Rico
Communications products
Willowdale, Canada
Communications products

Europe

Basingstoke, England
Communications products
Bordeaux, France
Semiconductor products
Camberly, England
Communications products
Copenhagen, Denmark
Communications products
E. Kilbride, Scotland
MCUs, logic, MOS digital/analog, MPUs, memory
Flensburg, Germany
Communications products
Munich, Germany
Semiconductor products
Stotfield, England
General information system products
Swindon, England
Cellular telephone products
Taunusstein, Germany
Communications products
Toulouse, France
Power products, telecom, consumer, regulators, op amps, auto, rectifiers

Asia/Pacific

Aizu Wakamatsu, Japan
Logic, power, standard cells, MCUs, memory
Chung Li, Taiwan
Communications products, semiconductor products
Kowloon, Hong Kong
Semiconductor products
Kuala Lumpur, Malaysia
Semiconductor products
Manila, Philippines
Communications products, semiconductor products
Melbourne, Australia
Communications products
Penang, Malaysia
Communications products
Sendai, Japan
DRAMs, SRAMs, FSRAMs, ASICs, MCUs

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Seoul, Korea
Communications products, semiconductor products
Seremban, Malaysia
Small-signal products
Singapore
Communications products
Tokyo, Japan
Communications products

ROW

Arad, Israel
Communications products
Guadalajara, Mexico
Power products
Leon, Mexico
Communications products
San Jose, Costa Rica
Communications products
Tel Aviv, Israel
Communications products, general information system products

SUBSIDIARIES

North America

Codex Corporation (United States)
Motorola Canada Ltd. (Canada)
Motorola Components de Puerto Rico Inc. (Puerto Rico)
Motorola Credit Corp. (United States)
Motorola International Corp. (United States)
Motorola International Development Corp. (United States)
Motorola Portatiles de Puerto Rico Inc. (Puerto Rico)
Motorola Portavoz de Puerto Rico Inc. (Puerto Rico)
Motorola Telcarro de Puerto Rico Inc. (Puerto Rico)
Universal Data Systems (United States)

Europe

Motorola GmbH (Germany)
Motorola Ltd. (United Kingdom)
Motorola Semiconducteurs S.A. (France)

ROW

Motorola Asia Ltd.. (Hong Kong)
Motorola Electronics Pte. Ltd. (Singapore)
Motorola Electronics Taiwan Ltd. (Taiwan)
Motorola Korea Ltd. (South Korea)
Motorola Malaysia Sdn. Bdh. (Malaysia)
Motorola Semiconductor Sdn. Bdh. (Malaysia)
Motorola de Mexico S.A. (Mexico)
Motorola Israel Ltd. (Israel)
Motorola Storno S.A. (Mexico)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Apple Computer Inc. and IBM Corporation
Motorola signed a preliminary technology agreement with Apple and IBM to share technology in the production of a new Motorola-produced RISC chip that will be the hardware base of a new entry-level software product to be developed and sold by IBM and Apple. This chip will also serve as the base hardware for future Apple Macintosh computers.

GRiD Systems
Motorola and GRiD signed an agreement allowing Motorola's Mobile Data division to become an official VAR for GRiD's laptop computer.

Integrated Micro Products Ltd.
Motorola and Integrated Micro Products signed an OEM agreement involving a special adaptation of the latter's fault-tolerant UNIX for use in Motorola's trunked radio systems for police and emergency radio services.

Lansdale Semiconductor Inc.
Lansdale purchased the exclusive rights to manufacture the DTL, HTL, RTL, and TTL military integrated-circuit series from Motorola.

Lockheed
Motorola and Lockheed will jointly conduct the Iridium global personal communications project. Lockheed will supply the 77 telecommunications satellites for the Iridium system.

Northern Telecom Limited
Motorola and Northern Telecom signed an agreement to develop major enhancements to their existing cellular products for global markets.

Ontario Systems Corp.
Ontario signed an agreement with Motorola licensing Ontario to sell Motorola's Delta 8000 RISC-based systems.

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OSC Communications Corp.
Motorola and OSC Communications agreed to cooperate in developing open cellular systems interface standards for worldwide cellular telephone markets.

PacTel Corp.
Motorola and PacTel signed an agreement to conduct an extensive field test and market trial of the code division multiple access (CDMA) digital cellular telephone technology.

Softsel Computer Products Ltd.
Softsel signed an agreement with Motorola allowing the former to distribute Motorola's Delta and M88000 RISC systems in the United Kingdom.

Tech Data Corp.
Motorola named Tech Data as a distributor of its Altair wireless ethernet products.

Unitrode Corp.
Motorola and Unitrode signed a technology partnership agreement to develop proprietary techniques to be used in the manufacture of direct wafer bonded silicon wafers.

XcelleNet Inc.
Motorola and XcelleNet signed a joint marketing agreement providing network access and information delivery capabilities for widely distributed organizations.

1990

BT Tymnet Inc.
BT Tymnet awarded Motorola a contract to provide networking for the Coverage PLUS vehicle communications system.

IBM
Motorola and IBM formed a joint venture to provide a nationwide radio data information service in the United States. The new service, called ARDIS, will give companies with mobile work forces access to company computer databases and information systems through two-way radio data terminals.

Interphase
Interphase signed a three-year OEM contract with Motorola valued at $8 million.

Liant Software
The companies reached a two-year agreement for Motorola to sell Liant's RM/COBOL-85 programming language system to users of Motorola's UNIX-based computer systems.

Philips International
Motorola and Philips signed an agreement to supply a full-screen, full-motion video IC for CD-Interactive applications.

Synopsys Inc.
Motorola and Synopsys signed a technology partnership agreement to jointly develop software libraries and models for Motorola's ECL ASICs.

Tekelec
Tekelec signed an agreement to supply Motorola with communications test equipment.

1989

Digital Equipment Corporation (DEC)
The companies will jointly design a fiber-distributed data interface chip set that Motorola will manufacture and market.

IBM
Motorola will fund and assign personnel to an R&D program for an X-ray lithograph project.

Interphase Corp.
Motorola bought 20 percent of this disk controller maker.

Oracle
Oracle will port its popular ORACLE relational database management system and related ORACLE tools to Motorola's M88000-based computer systems.

Philips International
The companies will cooperate on VSLI integrated circuits for interactive compact discs.

Thomson-CSF
Thomson-CSF will standardize its military and defense products to Motorola's M88000 RISC microprocessor family.

1988

Data General
Data General is to develop an ultrahigh-speed version of the M88000 RISC microprocessor family.

Omnirel
The two companies jointly introduced power MOSFET devices intended for military applications.

Unisoft Group
Unisoft is acting as Motorola's exclusive agent for future products based on UNIX Release V.

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MERGERS AND ACQUISITIONS

1991

UNIX Systems Laboratories
Motorola joined 10 other companies in the purchase of 20 percent of the stock of AT&T-owned UNIX Systems Laboratories.

KEY OFFICERS

George M. C. Fisher
Chairman of the board and chief executive officer

Gary L. Tooker
President and chief operating officer

Christopher B. Galvin
Senior executive vice president and assistant chief operating officer

Donald R. Jones
Executive vice president and chief financial officer

Arnold S. Brenner
Executive vice president and general manager, Japanese group

James Donnelly
Executive vice president and director of Personnel

David W. Hickie
Executive vice president and chief corporate staff officer

David G. Wolfe
Executive vice president and general manager, Government Electonics group

Edward F. Staiano
President and general manager, General Systems sector

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Information is not available.

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Table 3
Comprehensive Financial Statement
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Balance Sheet	1986	1987	1988	1989	1990
Cash	42.0	47.0	195.0	231.0	265.0
Receivables	851.0	1,101.0	1,400.0	1,683.0	1,857.0
Marketable Securities	143.0	211.0	145.0	202.0	312.0
Inventory	819.0	909.0	1,144.0	1,173.0	1,245.0
Other Current Assets	384.0	439.0	496.0	626.0	773.0
Total Current Assets	2,239.0	2,707.0	3,380.0	3,915.0	4,452.0
Net Property, Plants	2,140.0	2,329.0	2,854.0	3,337.0	3,778.0
Other Assets	303.0	285.0	476.0	434.0	512.0
Total Assets	4,682.0	5,321.0	6,710.0	7,686.0	8,742.0
Total Current Liabilities	1,371.0	1,668.0	2,691.0	2,751.0	3,048.0
Long-Term Debt	334.0	344.0	343.0	755.0	792.0
Other Liabilities	223.0	301.0	301.0	377.0	645.0
Total Liabilities	1,928.0	2,313.0	3,335.0	3,883.0	4,485.0
Common Stock	385.0	388.0	389.0	391.0	395.0
Other Equity	817.0	843.0	851.0	878.0	929.0
Retained Earnings	1,552.0	1,777.0	2,135.0	2,534.0	2,933.0
Total Shareholders' Equity	2,754.0	3,008.0	3,375.0	3,803.0	4,257.0
Total Liabilities and Shareholders' Equity	4,682.0	5,321.0	6,710.0	7,686.0	8,742.0

Source: Motorola Incorporated
Annual Reports
Dataquest (October 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Income Statement	1986	1987	1988	1989	1990
Revenue	5,888.0	6,727.0	8,250.0	9,620.0	10,885.0
U.S. Revenue*	4,124.0	4,482.0	5,269.0	5,997.0	6,063.0
Non-U.S. Revenue*	1,764.0	2,245.0	2,981.0	3,623.0	4,822.0
Cost of Sales	3,647.0	4,059.0	5,040.0	5,905.0	6,822.0
R&D Expense	481.0	524.0	665.0	810.0	1,008.0
SG&A Expense	1,431.0	1,659.0	1,957.0	2,289.0	2,414.0
Capital Expense	567.0	658.0	899.0	1,094.0	1,256.0
Pretax Income	265.0	416.0	612.0	646.0	666.0
Pretax Margin (%)	4.50	6.18	7.42	6.72	6.12
Effective Tax Rate (%)	46.00	40.00	34.00	34.00	34.00
Net Income	194.0	308.0	445.0	498.0	499.0
Shares Outstanding, Millions	126.5	128.9	129.7	130.0	131.7
Per Share Data					
Earnings	1.53	2.39	3.43	3.83	3.80
Dividend	0.64	0.64	0.67	0.76	0.76
Book Value	21.77	23.34	26.02	29.25	32.32

*Dataquest estimate

Source: Motorola Incorporated
Annual Reports
Dataquest (October 1991)

Table 5
Key Financial Ratios
Fiscal Year Ending in December

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	1.63	1.62	1.26	1.48	1.46
Total Assets/Equity (%)	170.01	176.89	198.81	202.10	205.36
Current Liabilities/Equity (%)	49.78	55.45	79.73	69.79	71.60
Total Liabilities/Equity (%)	70.01	76.89	98.81	102.10	105.36
Profitability (%)					
Return on Assets	4.14	5.79	6.63	6.48	5.71
Return on Equity	7.04	10.24	13.19	13.09	11.72
Profit Margin	3.29	4.58	5.39	5.18	4.58
Other Key Ratios					
R&D Spending % of Revenue	8.17	7.79	8.06	8.42	9.26
Capital Spending % of Revenue	9.63	9.78	10.58	11.37	11.54
Employees	94,400	97,700	102,000	104,000	115,400
Revenue (K)/Employee	62.37	68.85	80.88	92.50	94.32
Capital Spending % of Assets	12.11	12.37	13.01	14.23	14.37

Source: Motorola Incorporated
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Dataquest (October 1991)

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NEC Corporation

33-1 Shiba 5-chome
Minato-ku, Tokyo 108, Japan
Telephone: (03) 454-1111
Fax: (03) 452-6351
Dun's Number: 00-183-6014

Date Founded: July 1899

CORPORATE STRATEGIC DIRECTION

NEC Corporation (known as Nippon Electric Company Ltd. prior to April 1, 1983) was founded in 1899 to manufacture telephone sets and switchboards. NEC is a leading global supplier of a broad range of communications systems and equipment, computers and industrial electronic systems, electron devices, consumer electronics, and information services. The company bases its activities on the synergistic integration of computers and communications systems.

NEC divides its operations into five main product groups: Communications Systems and Equipment, Computers and Industrial Electronic Systems, Electron Devices, Home Electronic Products, and Other Operations. In 1990, the Computers and Industrial Electronic Systems group remained the largest in terms of percentage of total revenue, with sales totaling ¥1.5 trillion (U.S.$9.5 billion), which accounted for 43.7 percent of total revenue. (Percentage changes refer only to ¥ amounts; U.S.$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) This figure was up 13 percent from the group's 1989 revenue of ¥1.3 trillion (U.S.$8.4 billion). The biggest rate of increase in 1990 came from the Other Operations group, whose 1990 revenue of ¥192.9 billion represented a 23.7 percent increase over the 1989 total of ¥155.9 billion.

NEC reported consolidated revenue for fiscal year ending March 31, 1990, of ¥3.44 trillion, or approximately U.S.$22.2 billion, up 11.7 percent from fiscal 1989's total of ¥3.08 trillion (U.S.$19.5 billion). Net income rose 32.1 percent from ¥64.48 billion (U.S.$408.1 million) in fiscal 1989 to ¥85.22 billion (U.S.$539.4 million) in fiscal 1990.

NEC points to the strength of the domestic Japanese economy as a major contributor to its strong operating results. NEC operates 56 consolidated subsidiaries, 62 manufacturing plants, and more than 300 sales offices in Japan. Domestic sales in 1990 totaled ¥2.55 trillion, accounting for 74.0 percent of total sales. Overseas, NEC markets its products through a network of 68 subsidiaries and affiliates in 28 countries. Overseas sales increased 15.0 percent in 1990, climbing to ¥892.1 billion, or 25.9 percent of total revenue.

Capital expenditure increased 20.3 percent during fiscal 1990 to ¥343.8 billion, representing 10 percent of total revenue. Research and development expenditure totaled ¥552.9 billion for fiscal 1990, representing 16.1 percent of revenue.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region and distribution channel. Information on revenue by distribution channel is not available. Tables 3 through 5, at the end of this backgrounder, present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Computers and Industrial Electronic Systems

NEC's Computers and Industrial Electronic Systems group manufactures, designs, and markets a diverse product line of mainframe computers, personal computers, small business computers, peripherals, software, and industrial electronics systems. In 1990, sales of computers and industrial electronic systems rose 13.1 percent to ¥1.51 trillion, accounting for 43.8 percent of total sales.

NEC introduced a number of new products designed to strengthen and expand its product line in 1990. In

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February, NEC released the NEC System 3600 series of large-scale mainframe computers, a series featuring bipolar complementary metal oxide semiconductors (BiCMOS) to increase processing speed and reduce power consumption. NEC also added 12 new models to its popular PC-9800 series. Designed for scientific and engineering calculations, image processing, and communication that requires high-speed processing, the PC-H98 features new extended standard architecture, a 32-bit bus architecture offering a faster data transfer rate. Other PC-9800 series additions include the PC-9801N NOTE laptop and a new addition to the PC PowerMate series that adopts the extendeed industry standard architecture. In the software market, NEC released SPECDESSIN, a development support system for business-application software that improves efficiency in system design for mainframes.

NEC's PC product line centers around the PC-9800 and PowerMate series. According to Dataquest estimates, the PC-9801 XXXX was the sixth-rated model in the 1990 worldwide desktop computer market, with a market share of 2.09 percent based on 312,000 units shipped. NEC ranked third in the 1990 worldwide desktop market, trailing only IBM Corporation and Apple Computer Inc. NEC garnered 7.85 percent of the market with sales totaling $2.5 billion. The PC-9801 N/NV laptop computer was the leading model in the 1990 worldwide laptop D/C market, bringing in $319.9 million in factory revenue and an 8.11 percent market share. NEC ranked second overall in the 1990 worldwide laptop D/C market with an 18.17 percent market share and $715.6 million in factory revenue. NEC is also active in the computer storage market; Dataquest estimates that NEC ranked sixth in the total rigid disk drive market, with 2.1 million units shipped in 1990 and a 7.1 percent market share. The company's strongest entry in the storage market is 8- to 14-inch disk drives; NEC ranked third in the worldwide market in 1990 with a 13.8 percent market share.

Electron Devices

NEC is active in the production of various memories, microcontrollers, microcomponents, integrated circuits (ICs), gate arrays, and logic devices through its Electron Devices product group. The group's sales increased 7.1 percent to ¥605.9 billion in 1990, comprising 17.6 percent of total revenue. Dataquest estimates that NEC was the world leader in semiconductor sales in 1990, possessing an 8.4 percent market share based on $4.9 billion in factory revenue. NEC was also the worldwide market leader in 1990 in the total IC, the MOS Digital, and the MOS Logic markets with respective market shares of 8.9, 10.8, and 11.3 percent.

During fiscal 1990, NEC began production of 4Mb DRAMs at its manufacturing facilities in Yamaguchi and Kyushu. Production of 4Mb DRAMs also began in 1990 at NEC's new Hiroshima manufacturing plant. Other major accomplishments for the group in 1990 included a joint venture with AT&T Microelectronics of the United States, involving cooperation on semiconductor technologies such as gate arrays; the development of the world's fastest 4Mb SRAM; the introduction of the company's first 32-bit RISC products, the VR3000 and the VR3010; the release of a 75mW helium-neon (He-Ne) laser designed for spectral analysis and holography; and the release of a new gallium arsenide prescaler IC for VSATs that responds at frequencies up to 14 GHz.

Communications Systems and Equipment

Communications systems are an integral part of NEC's vision of "C&C," the company's corporate strategy of integrating computers and communication. NEC's product line in the communications industry includes digital switching systems, fiber-optic and radio transmission systems, space electronics, mobile communications systems, customer premises equipment, and broadcast equipment. The Communications Systems and Equipment group's revenue increased 9.1 percent in 1990 to ¥875 billion, representing 25.4 percent of total revenue.

Dataquest estimates that NEC ranked fifth in the 1990 North American PBX systems market with 309,400 lines installed and a 6.9 percent market share. NEC also ranked third in 1990 in Segment 5 of the North American facsimile equipment market with a 7.8 percent market share.

Major contracts in 1990 included an order for an optical submarine cable system, which will link Japan, Hong Kong, and the Republic of Korea. Two NEC satellites were released in 1990 by Japan's National AeroSpace Development Agency: the Momo-1b marine observation satellite and the Fuji 2 amateur radio satellite. NEC also strengthened its Integrated Services Digital Network (ISDN) product line in fiscal 1990 with the introduction of two new products: the G4 facsimile NEFAX D800, designed to meet the needs of ISDN services primarily in domestic financial institutions and local government, and the Advanced DK Series digital key telephone system.

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Home Electronics Products

Home electronics products in NEC's portfolio include color TV receivers and projectors, VCRs, videodisk players, and other small home electronics devices such as electronic diaries. The group's sales increased 16.8 percent to ¥264 billion in 1990, and accounted for 7.7 percent of total revenue. NEC has been active in the introduction of the state-of-the-art broadcast satellite visual audio home entertainment system. In 1990, the PARABOLA series of home-use direct broadcast satellite receiver systems was released, consisting of antennas, tuners, televisions, VCRs, and projection televisions using the new tuning systems.

Other Operations

Other services offered by NEC include value-added network (VAN) information services, electrical connectors, and measuring and testing systems. The Other Operations group was NEC's fastest-rising group in terms of revenue in fiscal 1990. The group's revenue increased 23.7 percent to ¥193 billion, representing 5.6 percent of total revenue.

The VAN information system has continued to gain widespread acceptance both in Japan and internationally. The number of subscribers to the company's PC-based VAN service doubled during 1990; the current total is more than 100,000 subscribers. In 1990, NEC released the C&C Marine VAN Service, which provides ships at sea with the same communications services offered to onshore subscribers. NEC also released the AF-8410P memory testing system in 1990, which boasts the world's highest test rate of 500 MHz.

Further Information

For further information about the company's business segments, please contact the appropriate industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	13,501	17,159	22,220	23,510	22,179
Percent Change	46.24	27.09	29.49	5.81	(5.66)
Capital Expenditure	1,648	1,326	2,016	2,148	2,176
Percent of Revenue	12.20	7.73	9.07	9.14	9.81
R&D Expenditure	1,836	2,629	3,496	3,657	3,499
Percent of Revenue	13.60	15.32	15.73	15.56	15.78
Number of Employees	95,796	101,227	102,452	104,022	104,022
Revenue ($K)/Employee	140.94	169.51	216.88	226.01	213.22
Net Income	153	103	205	485	539
Percent Change	(42.92)	(32.55)	98.54	137.07	11.26

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	N/A	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

Source: NEC Corporation
Annual Reports
Dataquest (October 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
Japan	67.00	72.00	73.00	75.00	74.00
All Others	33.00	28.00	27.00	25.00	26.00

Source: NEC Corporation
Annual Reports
Dataquest (October 1991)

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1990 SALES OFFICE LOCATIONS

Japan—More than 300
Overseas—170

MANUFACTURING LOCATIONS

Japan

Ando Electric
Measuring and testing systems
Anelva Corp.
Semiconductor manufacturing equipment, vacuum equipment
Anritsu Corp.
Communications and electronic equipment, measuring instruments
Anten Kogyo
Antennas, related equipment
Japan Aviation Electronics
Electrical connectors, electronic equipment
Kaijo Denki
Industrial marine equipment
NEC Akita
ICs, discrete semiconductor devices
NEC Data Terminals
Computer terminals
NEC Fukui
ICs, discrete semiconductor devices
NEC Fukuoka
ICs
NEC Fukushima
Communications equipment, related components
NEC Gunma
Computers, related systems
NEC Hiroshima
4Mb DRAMs
NEC Home Electronics
TVs, home electronic appliances, electronic parts
NEC Hyogo
Communications equipment parts
NEC Ibaraki
Computers, related systems
NEC Kagoshima
Electronic devices
NEC Kansai
ICs, discrete semiconductor devices, electronic devices
NEC Kofu
Development of computers
NEC Kumamoto
ICs
NEC Kyushu
ICs
NEC Miyagi
Communications equipment, related components
NEC Nagano
Home electrical appliances
NEC Niigata
Computers, related systems
NEC Oita
ICs
NEC Radio & Electronics
Communications equipment, related components
NEC Saitama
Communications equipment, related components
NEC San-ei Instruments
Medical electronic equipment, industrial measuring systems
NEC Shizuoka
Communications equipment, computer terminals
NEC Tohoku
Communications equipment, computer terminals
NEC Toyama
Electronic devices
NEC Yamagata
ICs, discrete semiconductor devices
NEC Yamaguchi
ICs
NEC Yonezawa
Communications equipment, computer terminals
Nico Electronics
Special communications equipment, vending machines
Nippon Avionics
Electronic equipment for aircraft
Nippon Electric Glass
CRTs, other glass products
Nippon Electric Industry
Electrical machinery, precision instruments
Nitsuko Ltd.
Communications equipment and parts
Showa Koki Seizo
Optical precision instruments
Takasago Ltd.
Telephones, communications equipment
Tama Electric
Resistors
Tohoku Metal Industries
Magnetic materials
Tokin Corp.
Magnetic materials, electric parts
Toyo Communication Equipment
Communications equipment and parts

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North America

NEC America
Faxes, printers, magnetic disk drives
NEC Electronics
256K DRAMs
NEC Home Electronics
Home electronic products, laptop PCs
NEC Information Systems
Office computers, printers, etc.
NEC Research Institute
R&D center

Europe

NEC Ireland
ICs
NEC Semiconductor, United Kingdom
256K DRAMs
NEC Technologies, United Kingdom
VCRs, printers, car telephones, faxes

Asia/Pacific

NEC Electronics Singapore
Linear ICs, 256K DRAMs
NEC Home Electronics, Malaysia
Home electronic products
NEC Semiconductor, Malaysia
ICs, discrete semiconductor devices
NEC Technologies, Thailand
Telephones
PERNAS NEC Telecommunications, Malaysia
Communications equipment
Siam NEC Company (Thailand)
Color TVs
Taiwan Telecommunications Ind.
Communications equipment

ROW

NEC Australia
ICs
NEC de Mexico
Communications equipment
NEC do Brazil
Telephone switching systems, radio equipment electronics
NEC Home Electronics, Australia
Color TVs
PECOM-NEC, Argentina
Digital electronic switching
Philco Argentina
TVs, radios, etc.

SUBSIDIARIES

Japan

ANELVA Corporation
Ando Electric Company Ltd.
Japan Aviation Electronics Industry Ltd.
NEC Akita Ltd.
NEC Data Terminals Ltd.
NEC Engineering Ltd.
NEC Factory Engineering Ltd.
NEC Field Service Ltd.
NEC Fukui Ltd.
NEC Fukuoka Ltd.
NEC Fukushima Ltd.
NEC Gunma Ltd.
NEC Home Electronics Ltd.
NEC Hyogo Ltd.
NEC Ibaraki Ltd.
NEC Information Service Ltd.
NEC Kagoshima Ltd.
NEC Kansai Ltd.
NEC Kumamoto Ltd.
NEC Kyushu Ltd.
NEC Miyagi Ltd.
NEC Nagano Ltd.
NEC Niigata Ltd.
NEC Oita Ltd.
NEC Radio & Electronics Ltd.
NEC Saitama Ltd.
NEC San-ei Instruments Ltd.
NEC Shizuoka Ltd.
NEC Software Ltd.
NEC System Integration & Construction Ltd.
NEC Tohoku Ltd.
NEC-Toshiba Information Systems Inc.
NEC Toyama Ltd.
NEC Warehouse and Distribution Ltd.
NEC Yamagata Ltd.
NEC Yamaguchi Ltd.
NEC Yonezawa Ltd.
Nippon Avionics Co. Ltd.

North America

HNSX Supercomputers Inc. (United States)
NEC America Inc. (United States)
NEC Business Communication Systems (United States)
NEC Canada Inc. (Canada)
NEC Electronics Inc. (United States)
NEC Industries Inc. (United States)
NEC Logistics America Inc. (United States)
NEC Research Institute Inc. (United States)

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NEC USA Inc. (United States)
NMI Corporation (United States)

Europe

NEC Business Systems (Italiana) s.r.l. (Italy)
NEC Deutschland GmbH (Germany)
NEC Electronics (Europe) GmbH (Germany)
NEC Electronics (France) S.A. (France)
NEC Electronics (Germany) GmbH (Germany)
NEC Electronics Italiana s.r.l. (Italy)
NEC Electronics (UK) Limited (United Kingdom)
NEC Finland OY (Finland)
NEC France S.A. (France)
NEC Electronics GmbH (West Germany)
NEC Iberia S.A. (Spain)
NEC Industries Netherlands B.V. (Netherlands)
NEC Scandinavia AB (Sweden)
NEC Semiconductors Ireland Limited (Ireland)
NEC Semiconductors (UK) Limited (United Kingdom)
NEC Technologies (UK) Ltd. (United Kingdom)
NEC (UK) Ltd. (United Kingdom)

ROW

Home Electronics Co. Ltd. (Thailand)
NEC Argentina S.A. (Argentina)
NEC Australia Pty. Ltd. (Australia)
NEC do Brasil S.A. (Brazil)
NEC Chile S.A. (Chile)
NEC Colombia S.A. (Colombia)
NEC Communication Systems (Thailand) Co. Ltd. (Thailand)
NEC Customer Services (Australia) Pty. Ltd. (Australia)
NEC Electronics Hong Kong Limited (Hong Kong)
NEC Electronics Singapore Pte. Ltd. (Singapore)
NEC Electronics Taiwan Limited (Taiwan)
NEC Engineering (Thailand) Co. Ltd. (Thailand)
NEC Home Electronics Australia Pty. Ltd. (Australia)
NEC Home Electronics (Malaysia) Sdn. Bhd. (Malaysia)
NEC Hong Kong Limited (Hong Kong)
NEC Information Systems Australia Pty. Ltd. (Australia)
NEC de Mexico, S.A. de C.V. (Mexico)
NEC Nigeria Limited (Nigeria)
NEC Sales (Malaysia) Sdn. Bhd. (Malaysia)
NEC Saudi Arabia Limited (Saudi Arabia)
NEC Semiconductors Sdn. Bhd. (Malaysia)
NEC Singapore Pte. Ltd. (Singapore)
NEC Taiwan Ltd. (Taiwan)
NEC Technologies Hong Kong Limited (Hong Kong)
NEC Technologies Philippines Inc. (Philippines)
NEC Technologies (Thailand) Co. Ltd. (Thailand)
NEC (Thailand) Ltd. (Thailand)
NEC de Venezuela (Venezuela)
New Zealand Telecommunications Systems Support Centre Limited (New Zealand)
PERNAS NEC Telecommunications Sdn. Bhd. (Malaysia)
Siam NEC Co. Ltd. (Thailand)
Taiwan Telecommunication Industry Co. Ltd. (Taiwan)
Tianjin NEC Telecommunications Engineering Co. Ltd. (China)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

AT&T Corporation
The two companies agreed to jointly produce digital car telephone systems targeted at Japanese communications companies. In a separate agreement, the two companies also agreed to jointly develop 0.35-micron CMOS technologies.

Robert Bosch GmbH
The two companies signed an agreement giving NEC worldwide rights to design, develop, and market large-scale integrated circuits that conform with Bosch's Controller Area Network specification.

DEC Corporation
NEC joined DEC's PowerFrame Synergy Programme, a union of 23 companies designed to promote industry standards in ASIC design.

IBM Japan Ltd.
NEC and IBM Japan signed an agreement whereby IBM Japan will market NEC's SX-3 supercomputer.

NTT Corporation
NEC and NTT signed a joint technology agreement dealing with the joint development of a digital portable telephone with a volume of only 195cc.

Otsuka Shokai and Matra Datavision K.K.
NEC and Otsuka Shokai made an agreement with Matra Datavision K.K., under which NEC and Otsuka Shokai will market a version of Matra Datavision's EUCLID-IS 3-D mechanical CAD/CAM/CAE software.

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Sanyo Corporation
Sanyo entered the UNIX engineering market by signing a technology agreement with NEC that allows Sanyo to sell NEC's EWS4800 Series engineering workstations.

Valid Logic Systems Inc.
Valid Logic Systems signed a $1 million technology development agreement with NEC for the development of analog IC tools.

1990

Hughes Aircraft Company
Hughes Aircraft licensed NEC to build C-Nite night-attack fire control equipment for Japanese Ground Self Defense Force AH-1S antitank helicopters.

Philips NV
NEC and Philips signed a licensing agreement to manufacture and market chips using Philips I(2)C-bus system technology.

Texas Instruments Inc. (TI)
NEC and TI renewed their five-year semiconductor patent cross-licensing agreement.

1989

MIPS Computer Systems Inc.
MIPS entered into a royalty-bearing technology exchange with Siemens and NEC for its RISC MPUs. NEC plans to manufacture the R2000A and R3000 devices and peripherals in Japan and Europe. Siemens will manufacture in Europe.

1988

Optoelectronics Research Labs
Photodiodes

Summit Microcircuits
64K/256K fast SRAMS

Enabling Technologies Inc.
Enabling Technologies entered into a strategic alliance with NEC Home Electronics (United States) to develop products and explore new technologies in graphics manipulation, animation, and optical media.

British Telecom U.K.
NEC's U.K. subsidiary, NEC Technologies, manufactures jointly developed car telephones for British Telecom.

Honeywell Bull
NEC Computer Systems and Honeywell Bull will cooperate in R&D of artificial intelligence.

Corvus Systems
NEC and Corvus Systems are involved in joint development of a CMOS single-chip controller.

Digital Research Incorporated
NEC has a joint-marketing agreement with Digital Research regarding a CP/M operating system for the V Series.

Oki
NEC has developed a CMOS signal processor (uPD77C20) with Oki.

Sharp Electronics Corporation
NEC and Sharp agreed to jointly develop and produce V Series microperipherals. Under the agreement, NEC will provide its original microperipherals to Sharp on an OEM basis, and Sharp will develop new microprocessors for NEC.

Sharp and Sony
Sharp and Sony have been announced as second sources for the NEC V Series.

MERGERS AND ACQUISITIONS

Information is not available.

KEY OFFICERS

Kenzo Nakamura
Chairman of the board

Tadahiro Sekimoto
President

Yoshiteru Ishii
Senior executive vice president

Koji Maeda
Senior executive vice president

Toshiro Kunihiro
Senior executive vice president

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PRINCIPAL INVESTORS

Sumitomo Life Insurance
Sumitomo Trust & Banking
Sumitomo Bank
Mitsubishi Trust & Banking
Nippon Life Insurance
Dai-ichi Mutual Life Insurance
Sumitomo Marine & Fire Insurance
Toyo Trust & Banking
Sumitomo Electric Industries
Sumitomo Corporation

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Table 3
Balance Sheet
Fiscal Year Ending March 31
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash	822.6	1,229.0	1,685.9	2,930.5	2,230.8
Receivables	3,635.7	4,670.8	5,987.3	6,568.7	6,329.5
Marketable Securities	437.0	558.8	404.9	442.9	424.3
Inventory	3,087.9	4,100.2	5,243.0	5,140.1	4,657.6
Other Current Assets	748.1	1,493.4	1,436.5	889.2	516.6
Total Current Assets	8,731.3	12,052.2	14,757.6	15,971.4	14,158.8
Long-Term Receivables and Investments	1,563.9	1,662.1	2,101.1	2,247.4	1,970.4
Net Property, Plants	3,621.0	4,395.2	5,490.5	5,787.7	6,061.6
Other Assets	612.8	834.9	1,077.5	1,154.6	1,125.6
Total Assets	14,529.0	18,944.4	23,426.7	25,161.1	23,316.4
Total Current Liabilities	7,987.6	10,162.9	12,878.5	13,234.8	12,408.9
Long-Term Debt	3,579.7	5,052.8	5,480.4	6,431.1	5,478.8
Other Liabilities	163.7	206.4	283.9	311.9	332.6
Total Liabilities	11,731.0	15,422.1	18,642.8	19,977.8	18,220.3
Common Stock	600.0	784.3	1,184.9	1,202.8	1,109.8
Additional Paid-In Capital	953.6	1220.0	1716.7	1842.9	1,700.9
Other Equity	44.9	49.1	64.0	75.1	289.8
Retained Earnings	1,199.7	1,470.0	1,818.8	2,068.9	1,995.7
Treasury Stock	(0.1)	(0.8)	(0.2)	(6.5)	(0.1)
Total Shareholders' Equity	2,798.2	3,523.4	4,784.4	5,189.7	5,096.2
Total Liabilities and Shareholders' Equity	14,529.1	18,944.7	23,427.0	25,161.0	23,316.4

Source: NEC Corporation
Annual Reports
Dataquest (October 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending March 31
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	13,501.3	17,159.1	22,219.5	23,509.5	22,179.2
Cost of Sales	8,868.7	1,1654.5	15,120.0	15,778.2	14,451.6
R&D Expense	1,836.2	2,629.2	3,495.7	3,657.4	3,499.3
SG&A Expense	3,422.9	4,492.3	5,863.0	6,011.2	5,869.9
Capital Expense	1,647.7	1,326.2	2,016.0	2,148.3	2,175.8
Pretax Income	661.9	397.6	566.0	993.9	1,099.6
Pretax Margin (%)	4.90	2.32	2.55	4.23	4.96
Effective Tax Rate (%)	58.00	58.00	56.00	56.00	54.00
Net Income	152.7	103.0	204.5	484.8	539.4
Shares Outstanding, Millions	1,387	1,408	1,469	1,494	1,520
Per Share Data					
Earnings	0.11	0.07	0.14	0.31	0.33
Dividend	0.05	0.06	0.07	0.07	0.07
Book Value	2.02	2.50	3.26	3.47	3.35
Exchange Rate (U.S.$1=¥)	178	146	124	133	158

Source: NEC Corporation
Annual Reports
Dataquest (October 1991)

Table 5
Key Financial Ratios
Fiscal Year Ending March 31

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	1.09	1.19	1.15	1.21	1.14
Total Assets/Equity (%)	519.23	537.67	489.65	484.83	457.53
Current Liabilities/Equity (%)	285.45	288.44	269.18	255.02	243.49
Total Liabilities/Equity (%)	419.23	437.71	389.66	384.95	357.53
Profitability (%)					
Return on Assets	1.05	0.54	0.87	1.93	2.31
Return on Equity	4.56	2.92	4.27	9.34	10.58
Profit Margin	1.13	0.60	0.92	2.06	2.43
Other Key Ratios					
R&D Spending % of Revenue	13.60	15.32	15.73	15.56	15.78
Capital Spending % of Revenue	12.20	7.73	9.07	9.14	9.81
Employees	95,796	101,227	102,452	104,022	104,022
Revenue ($K)/Employee	140.94	169.51	216.88	226.01	213.22
Capital Spending % of Assets	11.34	7.00	8.61	8.54	9.33
Exchange Rate (U.S.$1=¥)	178	146	124	133	158

Source: NEC Corporation
Annual Reports
Dataquest (October 1991)

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N.V. Philips Gloeilampenfabrieken

Groenewoudseweg 1
5621 BA Eindhoven
The Netherlands
Telephone: (31-40) 786022
Fax: (31-40) 785486
Dun's Number: 40-455-3240

Date Founded: 1891

CORPORATE STRATEGIC DIRECTION

N.V. Philips Gloeilampenfabrieken (Philips), incorporated in 1912, is a widely diversified multinational group of companies, engaged primarily in the manufacturing and distribution of electronic and electrical products, systems, and equipment. The legal entity, N.V. Gemeenschappelijk Bezit van Aandeelen Philips Gloeilampenfabrieken (Philips N.V.), operates solely as a holding company for share capital of N.V. Philips Gloeilampenfabrieken (Philips), of which it holds 99.99 percent. Philips Industries functions as the primary holding company for the company's numerous national organizations, which are wholly owned subsidiaries operating in over 60 countries. These subsidiaries' businesses vary from simple marketing organizations to fully integrated manufacturing and marketing concerns. Philips' product activities are grouped into five product sectors: Lighting, Consumer Products, Professional Products and Systems, Components, and Miscellaneous.

Fiscal year 1990 was a year of fundamental reappraisal for Philips. Persistently large losses on information systems and integrated circuits had been causing a drain on the company's equity and even threatening the continuation of healthy growth in other sectors. In Europe and the United States, the company's Lighting product sector had to contend with intense price competition, which could be only partly offset by improvements in efficiency. Furthermore, exchange rate movements and appreciable rises in interest rates had an adverse impact on both Philips' earnings and its competitiveness.

Against this backdrop, Philips decided that the measures taken in the past few years to enhance the company's maneuverability should be radically intensified and speeded up. A revitalization process was started with the aim of rapidly restoring the company to lasting profitability and improving its financial structure. As part of this revitalization process, drastic restructuring measures were taken to put Philips' Components product sector and Information Systems Division on a sound footing. At the same time, it was decided to launch a worldwide campaign to improve efficiency in all organizational units. This efficiency drive is aimed at achieving substantial cost reductions within a short period of time and at promoting a permanent mindset toward profit and costs. The campaign is also aimed at intensifying quality and customer orientation.

The measures to turn around the Components product sector and the Information Systems Division, in addition to the worldwide campaign to improve efficiency, will result in a reduction of 45,000 to 55,000 jobs between September 1990 and the end of 1991. In addition, since the end of 1990, Philips has been reappraising the organization and composition of the businesses in which the company operates. This portfolio analysis will result in the divestment, closure, or drastic reorganization of some units, while in other cases it will give rise to a strengthening and expansion of operations or the creation of alliances.

A total of F 4.6 billion (US$2.5 billion) was charged against operating income in fiscal 1990 for the implementation of the whole revitalization program. (Percentage changes refer only to F amounts; US$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) As a result, the year was concluded with a net loss of F 4.24 billion (US$2.34 billion).

In fiscal 1990, net revenue decreased 3 percent to F 55.76 billion (US$30.81 billion) from F 57.22 billion (US$26.87 billion) in fiscal 1989. However, the 1989 sales figure included Philips' defense businesses in Europe, which have since been disposed of. A

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number of other, smaller changes in consolidations took place as a result of the disposal and acquisition of other businesses. Disregarding the effects of these changes and of exchange rate movements, net sales on a comparable basis increased 5 percent in fiscal 1990.

Philips remains the world leader in lighting and color picture tubes and is second in size only to Matsushita, of which the company owns 35 percent, in consumer electronics revenue. On an overall basis, Philips' main revenue comes from the European market, which has accounted for approximately 60 percent of the company's total sales over the past five years.

The company's R&D expense decreased 4 percent to F 4.38 billion (US$2.42 billion) in fiscal 1990 from F 4.56 billion (US$2.14 billion) in fiscal 1989, but remained at approximately 8 percent of net revenue. This decline in R&D expenditure was entirely due to the divestment of Philips' defense businesses. Approximately 35,000 employees are engaged in product development and in the development of production methods and equipment. The responsibility for the development of products and production methods lies within each individual product division. The divisions have development laboratories at their disposal in 25 countries throughout the world.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 7, at the end of this backgrounder, present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Professional Products and Systems Division

The Professional Products and Systems Division comprises Communications Systems, Information Systems, Medical Systems, Industrial and Electro-Acoustic Systems, and Defense and Control Systems, all serving the professional market. Sales in the Professional Products and Systems Division decreased 17 percent to F 13.06 billion (US$7.21 billion) in 1990 and accounted for 23.4 percent of Philips' total revenue.

Communications Systems

The company's Communications Systems products include private branch exchanges and key telephone systems, cable transmission and network access equipment, switching and network management systems, radio trunk transmissions and subscriber access systems, copper and fiber-optic cables, and optical fiber. The company also produces car and cordless telephones, mobile radio truncated networks, and wide area paging systems.

In September 1990, AT&T repurchased Philips' 15 percent stake in AT&T Network Systems International B.V., which was founded in 1983 as AT&T-Philips Telecommunications. At its founding, Philips held 50 percent of the company, which makes and markets AT&T switches overseas. Philips then cut back its stake to 40 percent, and later transferred another 25 percent back to AT&T.

Information Systems

The company's Information Systems products include personal computers and workstations, document handling systems, optical media, peripherals, and dictation systems. In 1990, sales in this division declined as a result of sharp falls in prices affecting virtually all information systems products. As a result of reduced sales and low margins, appreciable losses were incurred in this division. According to Philips, radical restructuring measures are being carried out to remedy this situation.

Philips launched a number of new personal computer models in 1990 to help the company reach its new goals, which include a 5 percent market share by 1993. The company created two groups of PC products, one aimed at small businesses and home users and the other targeted at systems integrators, VARs, and corporate businesses. The company's new personal computers range from an entry-level 12-MHz 286-based system to a 25-MHz 486-based PC that features 4MB RAM and a hard disk drive expandable to 650MB.

During 1990, Philips introduced its first portable personal computer, the Magnavox Metalis/286, which has a 20MB hard drive and an internal 1.44MB 3.5-inch floppy drive. Targeted at the nonstop user, the Metalis/286 features battery life of up to four hours per charge, with full recharge in under four hours. It also features 1MB of RAM (expandable to 8MB), and is equipped with a backlit video graphics array (VGA) monitor.

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The company's image processing system, Megadoc, is based on optical recording. During mid-1990, Philips introduced the Megadoc 10, a PC-based version of Megadoc that can be networked but will be offered mainly as a standalone system. The Megadoc 10 runs unders MS-DOS, and conforms to UNIX System V.4 and Posix, enabling users to integrate existing software and add other applications more easily.

Smart cards, which are optical media products, are memory components that are the size of a credit card and contain an integrated circuit. Philips currently markets these cards for personal, business, and industrial applications. Sales have been slow for these cards because of cost/benefit factors.

Medical Systems

The company's Medical Systems activities focus primarily on the production of diagnostic imaging systems, such as equipment based on X-radiation (including computer tomography), ultrasound, and magnetic resonance. Philips also produces systems for radiation therapy and provides consultancy services on the operational structure within hospitals and clinics. The company's medical products are sold to hospitals, other institutions, and governments directly and, in certain countries, through agents. The market for medical systems is subject to rapid change due to developments in technology and diagnostic effectiveness.

Industrial and Electro-Acoustic Systems

The Industrial and Electro-Acoustic Systems Division concentrates on the production and marketing of products and systems for applications in research, industry, business, and government. A large range of electronic test and measuring equipment is produced, including oscilloscopes, logic analyzers, and automatic test equipment.

Defense and Control Systems

The Defense and Control Systems Division develops and produces electronic systems, subsystems, equipment, and strategic components for shipborne, land-based, and airborne military applications and civil derivatives. Products manufactured by this division include radars, optoelectronics, sonars, and electronic warfare equipment, including electronic systems measures, electronic countermeasures, electronic counter countermeasures, and chaff/flare launchers.

During 1990, significant steps were taken to reduce Philips' defense activities. The company disposed of a major portion of its Western European defense business to the French company Thomson-CSF, selling an 80 percent interest in Philips' Dutch subsidiary Hollandse Signaalapparaten B.V., along with that subsidiary's interest in the Belgium company MBLE Defense, and a 99 percent stake in Philips' French company TRT Defense. In addition, Philips sold its British defense businesses to Thorn-EMI, and disposed of its German defense activities via a management buy-out.

Components Division

The Philips Components Division is a supplier of components and subassemblies for both its own products and outside parties. Philips produces a broad range of components such as integrated circuits, discrete semiconductors, passive components, liquid crystal displays, and magnetic products. Component sales accounted for 14.6 percent of total net sales in 1990. Sales from this division fell 3.7 percent to F 8.16 billion (US$4.51 billion) in fiscal 1990 from F 8.74 billion (US$4.10 billion) in fiscal 1989.

Semiconductors

In early 1991, Philips removed its semiconductor activities from its Components Products Division to form the Semiconductor Products Division, which will handle all of Philips' IC and discrete semiconductor business. The new division will also encompass Philips Components-Signetics, a subsidiary located in Sunnyvale, California. According to Philips, the move will allow the company to react better to the rapid changes in the semiconductor market. Under the new structure, approximately one-third of Philips' employees in its Components Products Division will work in the Semiconductor Products Division, with the remainder (approximately 50,000) working in the scaled-down Components Product Division.

Philips considers its semiconductors to be the heart of its electronics product business. The company's general IC goal is to strengthen its position as an applications-oriented supplier to the world markets. According to Dataquest, Philips moved up one place to rank as the ninth-largest vendor in the worldwide semiconductor market in 1990, based on estimated factory revenue of $2.01 billion. Net sales for the company increased 17 percent, while as a whole, the semiconductor market grew at only 2 percent in

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calendar 1990. Among European semiconductor companies, Philips continued to be the top-ranked manufacturer, with the company's main competition in this region coming from SGS-Thomson Microelectronics B.V. and Siemens AG.

In the worldwide analog integrated circuit market, Philips jumped from fourth place to the leading position, holding a 6.2 percent market share based on estimated factory revenue of $653 million.

As part of the company's restructuring, an emphasis was placed on reducing losses in the Components Division. Along these lines, Philips pulled out of static RAM (SRAM) development and pilot production as one of several cost-cutting measures. The company also dropped out of the $5 billion Joint European Submicron Silicon (JESSI) program, a consortium of European chip vendors. Other cost-cutting actions included the closing of Philips' IC Advanced Development and Manufacturing center (located in Eindhoven) and concentration of advanced application-specific integrated circuit (ASIC) development in Hamburg, Germany.

Passive Components

The company is the world's leading supplier of passive components with product lines consisting of a variety of capacitors and resistors in both leaded and SMD versions. A wide range of crystals and oscillators is available for professional, industrial, and consumer equipment.

Consumer Products Division

The Consumer Products Division includes the consumer electronics product division, PolyGram Records division, domestic appliances, and personal care products. Major categories in consumer electronics are audio, video, and home office equipment. Sales in 1990 in the Consumer Products Division accounted for 45.5 percent of the total net sales. Sales increased 8.0 percent to F 25.40 billion (US$14.03 billion) in fiscal 1990 from F 23.58 billion (US$11.07 billion) in fiscal 1989.

Audio Products

Audio products include portable radios, radio receivers, car radios, receivers, amplifiers, tuners, cassette recorders, turntables, and compact disc systems. Compact disc players and changers are still the fastest-growing products in the consumer electronic market.

Video Products

Video products include television sets (including receivers equipped for Teletext and stereo sound), video recorders, and camera recorders (cameras with a built-in video recorder), very high resolution monitors, and other displays. Products in this sector are sold primarily to the OEM market. Philips brand names in the United States include Philips, Magnavox, Sylvania, and Philco.

Home Office Equipment

Home office equipment products include personal computers, videotex terminals, and other peripheral equipment, which are marketed specifically toward the home market. For personal computers for business applications, see Communications Systems.

Philips' Compact Disk Interactive (CD-I) system is an interactive, fully digital, multimedia system that allows audio, video, text, and graphics to be stored and integrated on a single compact disk. CD-I is scheduled to be introduced in the consumer market in the United States and Japan during late 1991 and in Europe in 1992.

PolyGram

Another division of the Consumer Products Division is PolyGram Records Inc., which engages primarily in the acquisition, production, marketing, and distribution of recorded music.

Domestic Appliances and Personal Care

The domestic appliances and personal care division includes home comfort and kitchen appliances, shavers, and other personal care products. Philips' main product of this division is Philishave, based on rotary shaving technology. Along with the other personal care products and domestic appliances, Philishave is marketed under the Norelco brand in the United States.

Lighting Division

The company has been in the lighting business since its founding in 1891. The Lighting Division's products serve a broad range of applications, including general lighting service lamps, gas-discharge and special lamps, fixtures, special products, and batteries. Net sales of the Lighting Division accounted for 12.6 percent of total net sales, or F 7.03 billion (US$3.88 billion). Lighting sales decreased 7 percent in fiscal 1990.

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Miscellaneous

Miscellaneous business activities, which are outside the company's basic range of products, include ancillary activities obtained as part of other acquisitions. Included in this sector are the operations in major domestic appliances in some countries that have not been transferred to Philips' joint venture with Whirlpool, begun in 1989. During 1990, Philips divested two of its larger U.S. subsidiaries incorporated in the Miscellaneous sector, Anchor Advanced Products Inc. and Genie Manufacturing Inc. Miscellaneous sales accounted for 3.8 percent of total net revenue in 1990. Sales in this division grew 8.0 percent to F 2.12 billion (US$1.17 billion).

Further Information

For further information about the company's business segments, please contact the appropriate Dataquest industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	22,464.1	25,968.0	28,322.7	26,865.7	30,808.8
Percent Change	-	15.60	9.07	(5.14)	14.68
Capital Expenditure	1,904.9	2,342.9	2,093.4	1,483.6	1,569.1
Percent of Revenue	8.48	9.02	7.39	5.52	5.09
R&D Expenditure	1,706.9	2,149.8	2,334.8	2,139.4	2,418.8
Percent of Revenue	7.60	8.28	8.24	7.96	7.85
Number of Employees	343,800	336,700	310,300	304,800	272,800
Revenue ($K)/Employee	65.34	77.12	91.28	88.14	112.94
Net Income	414.3	403.0	533.3	645.1	(2,342.5)
Percent Change	-	(2.73)	32.36	20.95	(463.15)
Exchange Rate (US$1=F)	F 2.45	F 2.03	F 1.98	F 2.13	F 1.81

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	7,080.7	7,480.1	7,247.0	9,001.1
Quarterly Profit	185.6	20.4	(1,192.8)	(1,355.8)

NA = Not available

Source: N.V. Philips Gloeilampenfabrieken Annual Reports and Forms 10-K Dataquest (October 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
Europe	59.20	61.40	61.30	57.30	60.90
North America	24.30	22.40	22.20	24.10	21.20
Asia/Pacific	7.60	8.60	8.70	10.00	10.50
ROW	8.90	7.60	7.80	8.60	7.40

Source: N.V. Philips Gloeilampenfabrieken Annual Reports and Forms 10-K Dataquest (October 1991)

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1990 SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

North America

Albuquerque, New Mexico
Wafer fabrication of MOS ICs
Orem, Utah
Wafer fabrication of bipolar ICs, assembly and testing of logic and bipolar memory products
Riviera Beach, Florida
Passive components, discrete semiconductors
Sunnyvale, California
Wafer fabrication, MOS and bipolar ICs
United States and Canada
All principal products

Europe

Barcelona, Spain
Diodes, transistors
Caen, France
Bipolar digital, bipolar analog, and consumer ICs; discrete devices, power transistors, optoelectronic products
Hamburg, Germany
NMOS microprocessors, controllers, memories, bipolar analog consumer ICs, small-signal transistors, varicap diodes
Netherlands
All principal products
Nijmegen, Netherlands
CMOS devices
Sittard, Netherlands
Not available
Southampton, United Kingdom
NMOS ROMs, dedicated consumer logic
Stadskanaal, Netherlands
Diodes
Stockport, United Kingdom
Power transistors, power diodes
Zurich, Switzerland
ICs

Japan

Tokyo, Japan
Testing

ROW

Africa
Lighting, consumer electronics, professional products and systems
Australia and New Zealand
Lighting, professional products, systems, components
Bangkok, Thailand
Assembly and testing
Hong Kong
Transistors, diodes
Kao-Hsiung, Taiwan
ICs
Latin America
All principal products
Manila, Philippines
Transistors, diodes, optoelectronic products
Recife, Brazil
ICs
Sao Paulo, Brazil
Discrete devices
Seoul, South Korea
Assembly and testing

SUBSIDIARIES

North America

North American Philips Corporation (United States)
Philips Canada Ltd. (Canada)
Philips Components-Signetics (United States)
PolyGram Records Inc. (United States)

Europe

Bang & Olufsen A/S (Denmark)
Compagnie Francaise Philips (France)
Europe Mij Voor Fabricage en Verkoop Van Gloeilampenonderdelen (E.M.G.O.) (Belgium)
Grundig Aktiengesellschaft (Germany)
Ibertica de Alumbrado S.A. (Spain)
Nederlands Philips Bedrijven B.V. (Netherlands)
Norsk Atkieselskap Philips (Norway)
Osterreichische Philips Industrie GesmbH (Austria)
Oy Philips AB (Finland)
Philips AG (Switzerland)
Philips and Du Pont Optical Company (Netherlands)
Philips Beteiligungs AG (Switzerland)
Philips Communication Systems International B.V. (Netherlands)
Philips Consumer Electronics International B.V. (Netherlands)
Philips Danmark A/S (Denmark)

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Philips Electronics Ireland Limited (Ireland)
Philips Export B.V. (Netherlands)
Philips GmbH (Germany)
Philips Iberica S.A.E. (Spain)
Philips Industrial S.A. Hellenique de Produits Electrotechniques et Electroniques (Greece)
Philips Information Systems International B.V. (Netherlands)
Philips International B.V. (Netherlands)
Philips International Finance S.A. (Luxembourg)
Philips Lighting Hellas Commercial and Industrial S.A. (Greece)
Philips Lighting Holding B.V. (Netherlands)
Philips Luxembourg Consumer Products (Luxembourg)
Philips Luxembourg Professional Systems (Luxembourg)
Philips Matsushita Battery Corporation (Belgium)
Philips Medical Systems International B.V. (Netherlands)
Philips Norden Aktiebolag (Sweden)
Philips Portuguesa S.A. (Portugal)
Philips S.A. (Belgium)
Philips S.A. Hellenique Commerciale de Produits Electrotechniques (Greece)
Philips Sistemi Medicali S.p.A. (Italy)
Philips Societa per Azioni (Italy)
Philips Systemes Medicaux (France)
Philips U.K. Limited (United Kingdom)
PolyGram GmbH (Germany)
PolyGram Leisure Ltd. (United Kingdom)
PolyGram N.V. (Netherlands)
PolyGram S.A. (France)
Turk Philips Aydinlatma Sanayi ve Ticaret Anonim Sirketi (Turkey)
Turk Philips Sanayi Anonim Sirketi (Turkey)
Turk Philips Ticaret Anonim Sirketi (Turkey)
Whirlpool International B.V. (Netherlands)

Japan

Japan New Media Systems Inc. (Japan)
Marantz Japan Inc. (Japan)
Matsushita Electronics Corporation (Japan)
Philips Japan Ltd. (Japan)
PNN Corporation (Japan)

ROW

Associated Electronic Products (Nigeria) Limited (Nigeria)
Audio Electronics Sdn. Bhd. (Malaysia)
Bangladesh Electrical Industries Limited (Bangladesh)
Bangladesh Lamps Limited (Bangladesh)
Beijing Philips Audio/Video Corporation (China)
Car Audio Electronics (China) Company Limited (China)
Electrical Lamp Manufacturers Thailand Limited (Thailand)
Elinthai Limited (Thailand)
El Nasr Company for Electrical and Electronic Apparatus (Egypt)
Hua Fei Colour Display Systems Company Ltd. (China)
Inbraphil-Industrias Brasileiras Philips Ltda. (Brazil)
Industria de Productos Electricos Centro-Americana, S.A. de C.V. (El Salvador)
Industrias Bolivianas Philips S.A. (Bolivia)
Industrias Philips de Colombia S.A. (Colombia)
Industrias Philips del Uruguay S.A. (Uruguay)
Industrias Venezolanas Philips S.A. (Venezuela)
Malaysian Lamps Sendirian Berhad (Malaysia)
Manufacture Nationale pour la Refrigeration et l'Electronique (Morocco)
PEC Investments Limited (South Africa)
Peico Electronics & Electricals Limited (India)
Philips Antillana N. V. (Netherlands Antilles)
Philips Argentina S.A. de Lamparas Electricas y Radio (Argentina)
Philips Bangladesh Limited (Bangladesh)
Philips Chilena S.A. (Chile)
Philips China Hong Kong Group Company Limited (Hong Kong)
Philips Components (Philippines) Inc. (Philippines)
Philips del Paraguay S.A. (Paraguay)
Philips do Brasil Ltda. (Brazil)
Philips Ecuador C.A. (Ecuador)
Philips Electrical Company of Pakistan Limited (Pakistan)
Philips Electrical Company of Thailand Limited (Thailand)
Philips Electrical Industries of Pakistan Limited (Pakistan)
Philips Electrical Lamps Inc. (Philippines)
Philips Electrical (Private) Limited (Zimbabwe)
Philips Electrical Zambia Ltd. (Zambia)
Philips Electric Lamps (E.A.) Limited (Kenya)
Philips Electronic Building Elements Industries Ltd. (Taiwan)
Philips Electronics Holdings Limited (South Africa)
Philips Electronics Industries Ltd. (Taiwan)
Philips Electronics Ltd. (South Korea)
Philips Electronics South-East Asia Holding B.V. (China)
Philips Ethiopia (Ethiopia)
Philips Hong Kong Limited (Hong Kong)
Philips Industrial Development Inc. (Philippines)
Philips Industries Holdings Limited (Australia)

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Philips Industries Ltd. (South Korea)
Philips Iran Ltd. (Iran)
Philips (Kenya) Limited (Kenya)
Philips Lighting Taiwan, Ltd. (Taiwan)
Philips Malaysia Sdn. Berhad (Malaysia)
Philips Maroc (Morocco)
Philips Mexicana, S.A. de C.V. (Mexico)
Philips Midden Oosten B.V. (Egypt)
Philips Midden Oosten B.V. (Iraq)
Philips Midden Oosten B.V. (United Arab Emirates)
Philips New Zealand Limited (New Zealand)
Philips Peruana S.A. (Peru)
Philips Semiconductor Corporation of Shanghai (China)
Philips Singapore Private Limited (Singapore)
Philips Taiwan Ltd. (Taiwan)
P.T. Philips Development Corporation (Indonesia)
P.T. Philips-Ralin Electronics (Indonesia)
Shenzhen Shen Fei Laser Optical Systems Company Limited (China)
Shenzhen Shen Fei Plastics and Metalware Company Limited (China)
Signetics Korea Co. Ltd. (South Korea)
Signetics Thailand Co. Ltd. (Thailand)
Taiwan Lighting Industries Co. Ltd. (Taiwan)
Taiwan Semiconductor Manufacturing Company Limited (Taiwan)
Thai Lamps Company Limited (Thailand)
Yangtze Optical Fibre and Cable Company Ltd. (China)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Matsushita Electric Industrial Co. Ltd. and Sony Corporation
The three companies formed a consortium in Japan to launch and promote Philips' Compact Disk Interactive (CD-I) multimedia technology. The company will be called CD-I Consortium Japan.

Sun Microsystems Inc.
Philips and Sun signed an agreement that will allow Philips to resell Sun's complete line of SPARCstations.

1990

BSO/Beheer B.V.
Philips service activities in the automation and information processing field were transferred to ORIGIN, a joint venture with the Dutch software company BSO/Beheer. That same year, the two companies formed a systems integration joint venture, called BSO/Pass International.

European Development Center
Philips joined the European Development Center, which develops and supports computer-aided engineering and design tools and technology.

Fujitsu Microelectronics
A second-source and joint development agreement was made for local area network circuits.

Matsushita Electric Industrial Co. Ltd.
A joint venture was formed to develop, control, and maintain a chip standard for domestic audio and video systems.

Motorola Incorporated
Philips and Motorola signed an OEM agreement under which Philips will add Motorola's reduced instruction-set computing systems to its product line.

Silicon Systems Inc. (SSI)
Philips licensed its QUBIC BiCMOS process to SSI to serve as the basis for mixed signal designs. As part of the agreement, both companies have access to the other's foundry to augment capacity availability as QUBIC grows in acceptance.

Teikoka Tsishin Kogyo
The two companies formed a joint venture for the manufacture of integrated control panels for consumer electronics equipment.

Tesla Strasnice and Hloubetin
Philips and Tesla, a Czechoslovakian electronics company, signed a cooperation agreement to improve the public telecommunications network in Czechoslovakia. The agreement will primarily focus on digital signal transmission equipment, which will facilitate multiple use of cable routes already laid.

Texas Instruments Incorporated (TI)
TI and Philips entered into a joint sourcing agreement for the ABT high-performance bus interface logic family.

VEB Kombinat Robotron
An agreement was reached concerning industrial measuring systems.

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1989

Catalyst Semiconductor Inc.
Philips signed an agreement with Catalyst to supply Catalyst with its I2C protocol.

Motorola Incorporated
An agreement was made to develop very large scale integration (VLSI) integrated circuits.

Seeq Technology Inc.
The companies signed a five-year agreement calling for Philips to second-source and codevelop the Seeq 512Kb and 1Mb flash EPROMs. Seeq will get an alternate source for its flash EEPROM and foundry support for its 64Kb and 256Kb EEPROMs.

Sun Microsystems Inc.
The two companies signed a licensing agreement that will allow Philips components to design and market 32-bit RISC microprocessors based on Sun's SPARC architecture.

Synercom Technology
The two companies have entered into an OEM agreement for Synercom's INFORMAP and related application software.

Whirlpool
Philips and Whirlpool entered into a joint venture agreement concerning major domestic appliances.

1988

ASM Lithography
ASM Lithography agreed to manufacture lithography equipment used to produce semiconductors for Philips.

AT&T
AT&T agreed to develop, manufacture, and sell telecommunications network products for Philips.

Canon Incorporated, Data General Corporation, Hewlett-Packard Company, Prime Computer Incorporated, and Unisys Corporation
Philips and these companies formed a consortium to establish a common way to implement object-oriented software technology across a network of computers and servers.

E.I. du Pont de Nemours and Sony Corporation
The companies agreed to set CD-WORM standards.

ES2
Philips adopted E-beam direct-wire technology for ASICs; ES2 adopted a Philips' CMOS process. Customers can have devices manufactured by either company.

Hitachi Ltd.
Hitachi will produce and sell Philips' HD68562 and HD64941 LSI chips.

Intel Corporation
The companies made an agreement giving Philips access to Intel's CHMOS process and products and Intel access to Philips' serial buses.

Intel Corporation
Philips was chosen to second-source Intel's 8095 16-bit MCU and use Intel's 256K EPROM technology.

Motorola Incorporated
Philips was chosen to second-source Motorola's 68010 16-bit MPU.

Plessey Co. plc
The companies are manufacturing microchips for satellite broadcasting receiver systems.

R. R. Donnelly & Sons and Toppan Printing Co. Ltd.
The companies agreed to develop software for interactive disks.

Robert Bosch GmbH
The companies agreed to develop a standardized pan-European automobile telephone system.

Siemens AG
Siemens agreed to furnish Philips with submicron technology.

SMH
The companies completed a CMOS wafer-fab production agreement.

Taiwan Semiconductor Manufacturing Co. (TSMC)
TSMC agreed to manufacture customer-specific ICs for Philips.

Texas Instruments Incorporated
TI made an agreement with Philips to develop and manufacture an advanced CMOS logic family.

Vitelec
Vitelec licensed Philips' process technology so that Vitelec could produce CMOS SRAMs for use, license, and sale for both companies.

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VLSI Technology Inc.
The companies made an agreement covering CAD design software, foundry services, cell libraries, and gate arrays under which VLSI would provide IC design software and Philips would provide foundry services.

Yangtze Optical Fiber Cable Company
The companies will manufacture and sell optical fiber cable in China.

MERGERS AND ACQUISITIONS

1991

E.I. Du Pont de Nemours and Company
Philips acquired Du Pont's interest in Philips & Du Pont Optical Company, a joint venture that was created in 1986 for the manufacture of optical disks.

1990

Bang & Olufsen A/S
Philips acquired a 25 percent interest in Bang & Olufsen, a Danish company that operates mainly at the top end of the audio and video market.

Marantz Japan
Philips acquired the majority shareholding in Marantz Japan and at the same time acquired rights to use the Marantz brand name in North America.

Robert Bosch Group
Philips' interest in the Broadcast Television Systems joint venture with Robert Bosch for the production of television studio equipment was increased from 50 percent to 75 percent.

1989

Taiwan Semiconductor Manufacturing Co. (TSMC)
Philips exercised its option to acquire 51 percent of TSMC's shares.

KEY OFFICERS

Jan D. Timmer
President, chairman of the board, chairman of Group Management (GMC)

W. Huisman
Chairman, Communication Systems Division

W. de Kleuver
Chairman of Components Division, member of GMC

Thierry Meyer
Chairman of Consumer Electronics Division, member of GMC

J.C. Tollenaar
Chairman, Domestic Appliances and Personal Care Division

F.A. de Bruijne
Chairman, Industrial Electronics Division

L.G. Nyberg
Chairman, Information Systems Division

E. Kloster
Chairman of Lighting Division, member of GMC

H. van Bree
Chairman, Medical Systems Divison

H.W. Hagmeister
Chairman, Semiconductors Division

A.M.I. Levy
Chairman, Polygram Records Division

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Gerard Philips

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Table 3
Balance Sheet
Fiscal Year Ending in December
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash	453.1	712.3	623.2	657.3	1,309.9
Receivables	4,956.7	5,870.0	6,749.5	6,565.3	6,469.6
Marketable Securities	69.8	175.9	97.0	69.0	81.8
Inventory	5,245.3	5,956.7	6,373.2	6,028.2	6,389.0
Other Current Assets	428.2	402.5	482.8	984.0	1,507.2
Total Current Assets	11,153.1	13,117.2	14,325.8	14,303.8	15,757.5
Net Property, Plants	7,447.8	9,106.9	9,372.7	8,730.5	9,222.7
Other Assets	2,064.5	2,376.4	2,992.9	2,777.5	3,525.4
Total Assets	20,665.3	24,600.5	26,691.4	25,811.7	28,505.5
Total Current Liabilities	7,531.8	9,159.6	9,739.9	10,046.0	10,965.7
Long-Term Debt	3,689.4	4,326.1	5,101.0	4,711.7	6,567.4
Other Liabilities	2,971.4	3,472.4	3,497.0	3,125.4	4,803.9
Total Liabilities	14,192.7	16,958.1	18,337.9	17,883.1	22,337.0
Common Stock	1,612.7	2,447.8	2,562.1	2,469.0	3,098.9
Other Equity	3,257.6	4,051.7	4,561.1	4,190.6	4,705.5
Currency Adjustment	(1,723.0)	(2,753.0)	(2,942.0)	(3,583.0)	(5,139)
Retained Earnings	3,325.7	3,896.1	4,172.2	4,852.1	3,503.3
Total Shareholders' Equity	6,472.7	7,642.4	8,353.5	7,928.6	6,168.5
Total Liabilities and Shareholders' Equity	20,665.3	24,600.5	26,691.4	25,811.7	28,505.5
Exchange Rate (US$1=F)	F 2.45	F 2.03	F 1.98	F 2.13	F 1.81

Source: N.V. Philips Gloeilampenfabrieken Annual Reports and Forms 10-K Dataquest (October 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	22,464.1	25,968.0	28,322.7	26,865.7	30,808.8
U.S. Revenue	13,289.8	15,942.4	17,344.9	15,403.3	18,768.0
Non-U.S. Revenue	9,174.3	10,025.6	10,977.8	11,462.4	12,040.9
Cost of Sales	16,776.3	19,553.2	21,344.9	20,252.6	23,020.4
R&D Expense	1,706.9	2,149.8	2,334.8	2,139.4	2,418.8
SG&A Expense	4,636.7	5,432.0	5,910.6	5,657.3	6,624.9
Capital Expense	1,904.9	2,342.9	2,093.4	1,483.6	1,569.1
Pretax Income	799.2	368.0	409.1	594.8	(2,266.3)
Pretax Margin (%)	3.56	1.42	1.44	2.21	(7.36)
Effective Tax Rate (%)	42.00	28.00	39.00	41.20	8.40
Net Income	414.3	403.0	533.3	645.1	(2,342.5)
Shares Outstanding, Thousands	230,957	245,500	256,252	266,508	NA
Per Share Data					
Earnings	1.79	1.64	2.08	2.42	(8.22)
Dividend	0.82	0.99	1.01	0.94	-
Book Value	28.03	31.13	32.60	29.75	NA
Exchange Rate (US$1=F)	F 2.45	F 2.03	F 1.98	F 2.13	F 1.81

Source: N.V. Philips Gloeilampenfabrieken Annual Reports and Forms 10-K
Dataquest (October 1991)

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Table 5
Balance Sheet
Fiscal Year Ending in December
(Millions of Guilders)

Balance Sheet	1986	1987	1988	1989	1990
Cash	1,110.0	1,446.0	1,234.0	1,400.0	2,371.0
Receivables	12,144.0	11,916.0	13,364.0	13,984.0	11,710.0
Marketable Securities	171.0	357.0	192.0	147.0	148.0
Inventory	12,851.0	12,092.0	12,619.0	12,840.0	11,564.0
Other Current Assets	1,049.0	817.0	956.0	2,096.0	2,728.0
Total Current Assets	27,325.0	26,628.0	28,365.0	30,467.0	28,521.0
Net Property, Plants	18,247.0	18,487.0	18,558.0	18,596.0	16,693.0
Other Assets	5,058.0	4,824.0	5,926.0	5,916.0	6,381.0
Total Assets	50,630.0	49,939.0	52,849.0	54,979.0	51,595.0
Total Current Liabilities	18,453.0	18,594.0	19,285.0	21,398.0	19,848.0
Long-Term Debt	9,039.0	8,782.0	10,100.0	10,036.0	11,887.0
Other Liabilities	7,280.0	7,049.0	6,924.0	6,657.0	8,695.0
Total Liabilities	34,772.0	34,425.0	36,309.0	38,091.0	40,430.0
Common Stock	3,951.0	4,969.0	5,073.0	5,259.0	5,609.0
Other Equity	7,981.0	8,225.0	9,031.0	8,926.0	8,517.0
Currency Adjustment	(4,222.0)	(5,589.0)	(5,825.0)	(7,632.0)	(9,302.0)
Retained Earnings	8,148.0	7,909.0	8,261.0	10,335.0	6,341.0
Total Shareholders' Equity	15,858.0	15,514.0	16,540.0	16,888.0	11,165.0
Total Liabilities and Shareholders' Equity	50,630.0	49,939.0	52,849.0	54,979.0	51,595.0
Exchange Rate (US$1=F)	F 2.45	F 2.03	F 1.98	F 2.13	F 1.81

Source: N.V. Philips Gloeilampenfabrieken Annual Reports and Forms 10-K Dataquest (October 1991)

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Table 6
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of Guilders, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	55,037.0	52,715.0	56,079.0	57,224.0	55,764.0
European Revenue	32,560.0	32,363.0	34,343.0	32,809.0	33,970.0
Non-European Revenue	22,477.0	20,352.0	21,736.0	24,415.0	21,794.0
Cost of Sales	41,102.0	39,693.0	42,263.0	43,138.0	41,667.0
R&D Expense	4,182.0	4,364.0	4,623.0	4,557.0	4,378.0
SG&A Expense	11,360.0	11,027.0	11,703.0	12,050.0	11,991.0
Capital Expense	4,667.0	4,756.0	4,145.0	3,160.0	2,840.0
Pretax Income	1,958.0	747.0	810.0	1,267.0	(4,102.0)
Pretax Margin (%)	3.56	1.42	1.44	2.21	(7.36)
Effective Tax Rate (%)	42.00	28.00	39.00	41.20	8.40
Net Income	1,015.0	818.0	1,056.0	1,374.0	(4,240.0)
Shares Outstanding, Thousands	230,957	245,500	256,252	266,508	NA
Per Share Data					
Earnings	4.39	3.33	4.12	5.16	(14.88)
Dividend	2.00	2.00	2.00	2.00	-
Book Value	68.66	63.19	64.55	63.37	NA
Exchange Rate (US$1=F)	2.45	2.03	1.98	2.13	1.81

NA = Not available

Source: N.V. Philips Gloeilampenfabrieken Annual Reports and Forms 10-K Dataquest (October 1991)

Table 7
Key Financial Ratios
Fiscal Year Ending in December

Key Financial Ratios	1986	1987	1988	1989	1985
Liquidity					
Current (Times)	1.48	1.43	1.47	1.42	1.44
Total Assets/Equity (%)	319.27	321.90	319.52	325.55	462.11
Current Liabilities/Equity (%)	116.36	119.85	116.60	126.71	177.77
Total Liabilities/Equity (%)	219.27	221.90	219.52	225.55	362.11
Profitability (%)					
Return on Assets	2.00	1.64	2.00	2.50	(8.22)
Return on Equity	6.40	5.27	6.38	8.14	(37.98)
Profit Margin	1.84	1.55	1.88	2.40	(7.60)
Other Key Ratios					
R&D Spending % of Revenue	7.60	8.28	8.24	7.96	7.85
Capital Spending % of Revenue	8.48	9.02	7.39	5.52	5.09
Employees	343,800	336,700	310,300	304,800	272,800
Revenue (FK)/Employee	160.08	156.56	180.73	187.74	204.41
Capital Spending % of Assets	9.22	9.52	7.84	5.75	5.50
Exchange Rate (US$1=F)	2.45	2.03	1.98	2.13	1.81

Source: N.V. Philips Gloeilampenfabrieken Annual Reports and Forms 10-K Dataquest (October 1991)

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Siemens AG

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Dun's Number: 31-606-7164

Date Founded: 1847

CORPORATE STRATEGIC DIRECTION

Siemens AG provides a comprehensive range of products from electronic components to office and telecommunication systems, and from production equipment, power, and medical engineering to transportation systems and automotive electronics. Siemens has positioned itself as a global company with sales to its domestic German market accounting for 45 percent and sales to the rest of world accounting for 55 percent of total worldwide sales in fiscal 1990. Currently, Siemens' operations in the United States exceed 10 percent of total sales.

Siemens AG is one of the world's major electrical engineering and electronics companies with 1990 sales of DM 63.1 billion (U.S.$39.2 billion). (Percentage changes refer only to DM amounts; U.S.$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) According to Dataquest, in 1990 semiconductor sales totaled DM 2.0 billion (U.S.$1.1 billion). This ranks Siemens as Europe's third-largest semiconductor company. Its data and information systems sales of DM 7.7 billion (U.S.$4.8 billion) rank the company as one of the world's largest information systems vendors. And with public and private telecommunication equipment sales of DM 13.8 billion (U.S.$8.6 billion), Siemens is one of the world's largest telecommunication vendors.

In April 1990, Siemens acquired a majority interest of common stock in Nixdorf Computer AG. On October 1, 1990, the Data and Information Systems Group was integrated into Nixdorf to form Siemens Nixdorf Informationssysteme AG (SNI). The integration of Siemens and Nixdorf represents a major expansion of the company. Although the company planned to increase business volume by nearly DM 6 billion (U.S.$3.7 billion), in April 1991, Siemens AG announced that Siemens Nixdorf Informationssysteme AG had a loss of DM 348 million (U.S.$216 million) worldwide.

In October 1990, the activities of Dr.-Ing Rudolf Hell GmbH were transferred to Linotype AG. Siemens, which was the parent company of Hell, holds a minority interest in the company, which has been renamed Linotype-Hell AG. The two companies together will have an estimated annual revenue of approximately DM 500 million (U.S.$310.4 million). This makes the company one of the largest electronic prepress companies in the industry.

In October 1990, Siemens acquired 49 percent interest in Mannesmann Tally GmbH, a computer printer manufacturer. This places Europe's printer industry in a very strong position. Mannesmann Tally was quick to maximize on the broadened range of products by introducing a new printer that was designed by Siemens AG.

In November 1990, Siemens acquired a 50 percent stake in Stromberg-Carlson Corporation, a U.S. telephone exchange business from GEC Plessey Telecommunications Ltd. (GPT). Siemens merged its Siemens Private Communication Systems Inc. with Stromberg-Carlson to create Siemens Stromberg-Carlson and became one of the largest U.S. public network equipment suppliers.

In addition, several structural changes took place within the company. The former Peripherals and Terminals Group was dissolved as of April 1, 1990; its fields of operation were assigned to units involved in related product lines.

Currently, Siemens AG has 13 business groups, 2 special divisions, and 1 legally independent unit. The 13 business groups include: Industrial and Building

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Systems, Drives and Standard Products, Automation, Automotive Systems, Power Generation (KWU), Power Transmission and Distribution, Semiconductors, Medical Engineering, Public Communication Networks, Passive Components and Electron Tubes, Private Communication Systems, Defense Electronics, and Transportation Systems. The two special divisions are Audio and Video Systems and Electromechanical Components; the legally independent unit is Osram GmbH.

Siemens' strategy is to further enhance its position in Europe in all important sectors of electrical engineering and electronics while continuing to build a broad business base in the United States. Siemens' goal in the new German states is to achieve the same market position that it enjoys in the western part of the country. Over the next few years, Siemens plans to invest more than DM 1 billion in the new German states and to employ locally some 25,000 to 30,000 people in research and development, production, distribution, installation, and service. During 1990, Siemens employed 373,000 people worldwide, which is a 2 percent increase from 1989.

Siemens' sales by business segment, excluding intersegment sales, were as follows for fiscal 1990: Power Generation, 5.8 percent; Power Transmission and Distribution, 5.0 percent; Industrial and Building Systems, 7.6 percent; Drives and Standard Products, 6.3 percent; Automation, 5.5 percent; Data and Information Systems, 7.7 percent; Private Communication Systems, 4.8 percent; Defense Electronics, 1.1 percent; Transportation Systems, 1.2 percent; Automotive Systems, 1.8 percent; Medical Engineering, 6.6 percent; Public Communication Networks, 9.1 percent; Semiconductors, 2.0 percent; Passive Components and Electron Tubes, 1.7 percent; Electromechanical Components, 0.8 percent; Audio and Video Systems, 0.1 percent; Osram, 2.6 percent; Hell, 1.0 percent.

Total revenue increased by 20.7 percent to DM 63 billion (U.S.$39.2 billion) in fiscal 1990 from DM 61 billion (U.S.$32.5 billion) in fiscal 1989. Net income increased 23.5 percent to DM 1.7 billion (U.S.$1.1 billion) in fiscal 1990 from DM 1.5 billion (U.S.$931 million) in fiscal 1989.

Research and development expenditure totaled DM 7.0 billion (U.S.$4.3 billion) in fiscal 1990, representing 6.9 percent of revenue. Capital spending totaled DM 7.0 billion (U.S.$4.4 billion) in fiscal 1990, representing 7.0 percent of revenue. In fiscal 1990, approximately 43,000 employees worldwide were engaged in R&D activities. About 90 percent of the R&D work was carried out by the operating groups, while the remaining 10 percent was done by the Corporate Research and Development and the Corporate Production and Logistics Division.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information is not available on revenue by distribution channel. Tables 3 through 7 at the end of this backgrounder present comprehensive financial information. The financial information does not include Nixdorf Computer AG because its consolidation will not be completed until the 1990 to 1991 fiscal year.

BUSINESS SEGMENT STRATEGIC DIRECTION

Data and Information Systems

The activities of Data and Information Systems were transferred to Siemens Nixdorf Informationssysteme AG in October 1990. With a spectrum ranging from notebook PCs to advanced mainframes, from organizational solutions for offices and plants to networks for large companies with global operations, Siemens Nixdorf Informationssysteme AG is the largest European computer manufacturer.

The Data and Information Systems segment contributed significantly to Siemens' overall growth in 1990. New orders increased 15 percent to DM 7.5 billion (U.S.$4.7 billion) and sales increased 28 percent to DM 7.7 billion (U.S.$4.8 billion) from 1989. This growth was significantly higher than the industry average and increases were registered in both domestic and international markets. Siemens believes that a major share of this favorable business was attributable to BS2000-driven, general-purpose computers. For the third straight year, the MX300 and MX500 Sinix computer families led both German and European markets for multiuser computers using the UNIX operating system. The company's market position for special systems, such as point-of-sale terminals, also continued to grow.

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Mainframes

The 7500 Series of general-purpose computers using the BS2000 operating system offers a broad spectrum ranging in performance from 1 to 100 mips, covering desktop units to large general-purpose computers. The BS2000, with its high degree of upward compatibility, is seen as a main foundation for development and has been merged with BASF's plug-compatible marketing arm to form Comparex. Siemens is attempting to gain more market share in the IBM mainframe market.

Midrange

Growth in the MX300 and MX500 Sinix computer families led both German and European markets for multiuser computers using UNIX operating systems. The MX300 and MX500 systems can connect up to 24 and 64 terminals, respectively. During 1990, the WX200 Sinix workstation was one of the new products introduced. Siemens supplied one of the largest suppliers of UNIX-based multiterminal systems in Europe.

Personal Computers

MS-DOS PC sales almost doubled during fiscal 1990. Growth was especially high in the high-performance category. This was, in part, the result of developing a highly regarded line of fully MS-DOS-compatible PC models. The two main lines are the PC D-2, which is based on the Intel 80286 processor, and the PC D-3, which is based on the 80386 processor.

Industry Standards

Siemens strongly supports European data processing standards and was a founding member of the X Open group of European Companies working on development of a common applications environment.

Peripherals and Terminals

Although the peripherals and terminals accounted for about one-fifth of the Peripherals and Terminals Group business in 1989, the activities were transferred to Data and Information Systems of Siemens Nixdorf Informationssysteme during 1990. The strongest growth was in personal computers, fax machines, office printers, and telephone terminals, especially digital feature phones.

Telecommunication

In the telecommunication business, Siemens has a global presence as a participant or leader in all of the crucial standards-making committees of the CCITT. It is strongly entrenched in Europe and has a solid reputation for well-engineered and well-manufactured products. It also has developed an expertise in ISDN. Siemens plans to install 200,000 lines in the former East Germany and to acquire a large share of this market.

In 1990, ROLM Systems, which develops and manufactures communications systems, was integrated into Siemens Private Communication Systems Inc. (SPCS). ROLM Company, however, is a joint venture that is equally owned by IBM Corporation and Siemens. It distributes the communications systems in the United States manufactured by ROLM Systems.

PBX

In October 1990, Siemens reorganized its PBX-related communications businesses in the United States. This created a new company called Siemens Private Communication Systems Inc. This new company includes ROLM Systems, Tel Plus Communications and Siemens' interest in ROLM Company, a 50-50 joint venture with IBM. ROLM is the third largest PBX supplier in the United States, with 14.0 percent market share, while Siemens ranks sixth with 3.9 percent. SPCS will include a PBX development division, a manufacturing plant, and the Gold Seal Dealer marketing and government sales units. Part of the new company will also include such support functions as financial controls, strategic planning, market research, and marketing communications. During 1990, the company's business in Spain and the Netherlands developed particularly well.

ISDN

This business is expected to grow because of the computer-aided telephony access to ISDN. Smaller systems and worldwide networking are examples of services that offer additional benefits. In an effort to avoid problems, including interoperability, that have stood in the way of the acceptance of ISDN, an agreement was made between AT&T, Northern Telecom, Inc., and Siemens Stromberg-Carlson to implement key ISDN standards. The companies hope that the service may be extended to millions of users by the end of 1992.

Digital Public Telephone Switching System

Siemens entered into alliances in eastern Germany with former state-owned businesses, including a

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Leipzig plant that will manufacture public telephone switching systems (EWSD). The merger of Stromberg-Carlson with U.S.-based Siemens Communication Systems Inc. provided additional market share in the United States. During fiscal 1990, 107 telecommunication administrators worldwide ordered EWSD exchanges. A total of approximately 28 million lines were ordered or delivered, which is an increase of approximately 50 percent over fiscal 1989. In addition, the first contract for the installation of a digital telephone network was signed in the new German states.

Defense

In the defense sector, the acquisition of Plessey operations strengthened its competitive position. The integration of two British companies, Siemens Plessey Defence Systems Ltd. and Siemens Plessey Radar Ltd., provided Siemens with local production facilities in two of Europe's key regional markets—Great Britain and Germany.

Higher sales volumes were generated primarily by the Patriot air defense missile system. Siemens is the general contractor in charge of adapting Patriot for German defense requirements. Current political developments are expected to cause substantial changes in the structures of NATO and the German Federal Armed Forces and will, therefore, affect previously planned development and procurement projects.

Semiconductors

Siemens reached a technological level equal to that of its major competitors with the Mega Project, its megabit DRAM development project. Although shipments of 4Mb DRAMs doubled during 1990, revenue dropped because of falling prices. During fiscal 1990, the semiconductor business was marked by a dramatic fall in memory prices and fierce competition, precipitated by excess capacity on the world market and the declining exchange rates of the dollar and the yen.

In fiscal 1990, the Semiconductor group's new orders decreased 12 percent to DM 2.1 billion (U.S.$1.2 billion) and sales decreased 12 percent to DM 2.0 billion (U.S.$1.1 billion). Siemens attributes this drop in revenue to the dramatic fall in semiconductor prices, fierce competition, and the declining exchange rates of the dollar and the yen.

In addition, IBM and Siemens signed an agreement to manufacture 16Mb DRAM chips at IBM's facility in Corbeil-Essonnes, France. Production is to begin at the end of 1991, with output set for the second half of 1992.

Further Information

For further information about the company's business segments, please contact the appropriate Dataquest industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	21,669.6	28,572.8	33,356.2	32,514.9	39,245.3
Percent Change	1.17	31.86	16.74	(2.52)	20.70
Capital Expenditure	3,155.8	2,951.7	2,927.0	4,187.4	4,388.8
Percent of Revenue	6.71	5.74	4.93	6.85	6.95
R&D Expenditure	2,488.9	3,450.6	3,640.4	3,656.9	4,335.4
Percent of Revenue	5.29	6.71	6.13	5.98	6.86
Number of Employees	359,000	359,000	353,000	365,000	373,000
Revenue ($K)/Employee	60.36	79.59	94.49	89.08	105.22
Net Income	679.3	708.3	781.5.1	838.8	1,036.0
Percent Change	30.71	4.28	10.32	7.34	23.51
Exchange Rate (U.S.$1=DM)	2.17	1.80	1.78	1.88	1.61

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

Source: Siemens AG
Annual Reports
Dataquest (November 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
Germany	45	49	52	47	45
International	55	51	48	53	55

Source: Siemens AG
Annual Reports
Dataquest (November 1991)

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1990 SALES OFFICE LOCATIONS

North America—70
Europe—88
Asia/Pacific—25
Japan—2
ROW—60

MANUFACTURING LOCATIONS

Information is not available.

SUBSIDIARIES

North America

Nixdorf Computer Corporation
Siemens Automotive Ltd. (Canada)
Siemens Electric Ltd. (Canada)
Siemens Automotive L.P. (United States)
ROLM Systems (United States)
Siemens Private Communication Systems Inc. (United States)
Siemens Components Inc. (United States)
Siemens Energy & Automation Inc. (United States)
Siemens Information Systems (United States)
Siemens KWU Inc. (United States)
Siemens Medical Systems Inc. (United States)

Europe

ATEA N.V. (Belgium)
Dr.-Ing Rudolf Hell GmbH (Germany)
Duewag Aktiengesellschaft
Heimann GmbH (Germany)
Interatom GmbH (Germany)
Nixdorf AG (Switzerland)
Nixdorf Computer AG (Germany)
Nixdorf Computer France S.A. (France)
Nixdorf Computer Ges.m.b.H. (Austria)
Nixdorf Computer Ltd. (England)
Nixdorf Computer S.A (Spain)
Nixdorf Computer A.G. (Switzerland)
NRG Nuklearrohr-Gesellschaft GmbH (Germany)
Osram GmbH (Germany)
Ostram Ltd. (England)
Osram S.A. (France)
Osram S.A. (Spain)
Osram-GEC Ltd. (United Kingdom)
Osram Societa Ruinite Osram Edison-Clerici S.p.A. (Italy)
Rofin-Sinar Laser GmbH (Germany)
Siemens AB, Stockholm (Sweden)
Siemens A.E., Elektrotechnische Projekte und Erzeugnisse (Greece)
Siemens AG Osterreich (Austria)
Siemens-Albis AG (Switzerland)
Siemens A/S (Denmark)
Siemens A/S, Oslo (Norway)
Siemens Automotive S.A (France)
Siemens Beteiligungen AG (Switzerland)
Siemens-Elema AB (Sweden)
Siemens Finanzierungsgesellschaft furr Informationstechnik GmbH (Germany)
Siemens Ltd., Dublin (Ireland)
Siemens Ltd., London (United Kingdom)
Siemens Matsushita Components GmbH & Co. (Germany)
Siemens Miet- und Portfolio- GmbH & Co. OHG, (Germany)
Siemens Nederland N.V. (Netherlands)
Siemens Osakeyhtio (Finland)
Siemens plc (England)
Siemens Plessy Electronic Systems Ltd. (England)
Siemens S.A. (Belgium)
Siemens S.A. (France)
Siemens S.A., Lisbon (Portugal)
Siemens S.A., Madrid (Spain)
Siemens S.p.A. (Italy)
Siemens Telecomunicazioni S.p.A. (Italy)
Siemensstadt-Grundstucksverwaltung GmbH & Co. (Germany)
Sietec Siemens-Systemtechnik und Portfolio GmbH & Co. (Germany)
Simko Ticaret ve Sanayi (Turkey)
Turk Siemens Kablo ve Elektrik Sanayii A.S. (Turkey)
Vacuumschmelze GmbH (Germany)

Japan

Siemens K.K. (Japan)

ROW

Equitel S.A. (Argentina)
Osram Argentina S.A.C.I. (Argentina)
Osram do Brasil-Companhia de Lampadas Electricas S.A. (Brazil)

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Osram S.A. de C.V. (Mexico)
Siemens Components (Pte.) Ltd. (Singapore)
Siemens Components Sdn. Bhd. (Malaysia)
Siemens Ltd. (Australia)
Siemens Ltd. (India)
Siemens Pakistan Engineering Co. Ltd. (Pakistan)
Siemens Ltd. (South Africa)
Siemens S.A. (Columbia)
Siemens S.A. (Venezuela)
Siemens S.A. de C.V. (Mexico)
Siemens S.A., Sao Paulo (Brazil)
Siemens S.A.I.C.F.I.yM. (Argentina)
Siemens Western Finance N.V. (Netherlands Antilles)
Taicom Systems Ltd. (Taipei)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Appian Technology
Appian Technology signed an agreement to supply Siemens with custom VGA graphics boards for a range of personal computers.

AT&T, Siemens Stromberg-Carlson, and Northern Telecom Inc.
An agreement was developed among AT&T, Siemens Stromberg-Carlson, and Northern Telecom Inc. These companies will begin to implement ISDN standards in order to extend the service to millions of users by 1992.

China Great Wall Industry
Siemens signed an agreement that allows two factories to build the Hicom 300 private branch exchange system. The agreement was signed with China Great Wall Industry and permits each of the factories to produce up to 100,000 subscriber lines per year within 4 years.

GPT Ltd.
GPT Ltd. and Siemens AG merged their British PABX distribution operations to create a joint venture. GPT Sales and Service and Siemens Communications Systems are being merged to form GPT Communications Systems. Siemens will have a 50 percent ownership.

Gandalf Technologies
Siemens and Gandalf Technologies have agreed to jointly market Gandalf's communications server and Siemen's PBX. Under the agreement, Gandalf's Starmaster server and Siemen's Hicom PBX will supply customers with ISDN-LAN connections.

IBM Corporation
IBM and Siemens signed a contract to build a factory that will manufacture 16Mb DRAM microprocessors at an estimated cost of $700 million. The facility is planned to be located in Corbeil-Essonnes. The agreement leaves room for additional partners providing the plant produces more microprocessors than the two companies need themselves. As part of the agreement Siemens will use the chips in specialized products, while IBM will use the chips in its own machines.

Matsushita Electric Industrial Company Ltd.
Matsushita and Siemens Nixdorf Informationssysteme AG signed an alliance to exchange personal computers in Europe. Siemens will sell Matsushita notebook computers under its own name, and Matsushita will sell Siemens machines under its Panasonic trade name in Europe. Under the agreement, the equipment will be jointly developed by both companies' R&D operations in their respective countries.

Motorola Incorporated
Motorola and Siemens agreed to jointly market equipment for contracts under a $30 billion European cellular network.

Nippon Telephone and Telegraph (NTT)
NTT selected Siemens to participate in the development of the Visual, Intelligent and Personal program. Fiber optic cables and the asynchronous transfer mode principle will be the technological basis of various services for speech, text, data, and pictures.

Storage Technology Corporation
Storage Technology and Siemens Nixdorf agreed to merge their nonimpact printer operations in the United States in a joint venture that became operational in January 1991. Siemens Nixdorf owns 51 percent, and Storage Technology owns 49 percent.

SynOptics Communications Inc.
Siemens signed a three-year OEM agreement with SynOptics Communications (Santa Clara, California) in which Siemens will market LAN products such as concentrators, ethernet, and token-ring connections in Europe.

1990

VEB Robotron
Siemens and VEB Robotron plan to enter into a joint venture. The software and computer systems company will be based in Dresden.

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BB-Data Gesellschaft

Siemens and BB-Data Gesellschaft fuer Informations-und Kommunikationssysteme are to cooperate in marketing the BB-Data Domino CASE tool. The companies also will jointly market tools for Computer Reverse Engineering (CARE). Siemens will support BB-Data in the development of further Domino products.

Digital Equipment Corporation, Hewlett-Packard Company, IBM Corporation, Unisys Corporation

Siemens has established worldwide PBX and computer teaming alliances with Digital Equipment, Hewlett-Packard, IBM, and Unisys to provide voice/data solutions to end users.

SGS-Thompson

Siemens and SGS-Thompson agreed to cooperate in the field of high-performance microcontrollers. The objective is to provide a comprehensive and integrated common solution for high-end 8-bit and 16-bit MCU applications. Siemens and SGS-Thompson also entered into a cooperative agreement wherein both companies agreed to act as second sources for each other's high-performance microcontrollers in 8-bit and 16-bit applications.

Unitrode

Siemens and the Micro Networks Division of Unitrode entered into a licensing agreement. Under the agreement, Micro Networks will sell Siemens' high-speed flash A/D converters. The licensing agreement initially covers the purchase and repackaging of Siemens' 6-bit and 8-bit, 75-MHz to 300-MHz sampling A/Ds.

Chinon Industries Inc.

Siemens and Chinon Industries entered into an agreement to cooperate in the development, production, and marketing of peripherals for PCs and of communications devices. The companies also plan to cooperate in the development of facsimile machines and image scanners.

VEB Numerik Karl Mark, VEB Niles, WMV International Handelgesellschaft

Siemens, VEB Numerik Karl Mark, VEB Niles, and WMV International Handelgesellschaft will form a joint venture to produce electrical and electronic machine tool equipment.

Analogy Inc.

Siemens and Analogy entered into an OEM agreement. Under the terms of the agreement, Siemens will market and support Saber as an OEM product worldwide, integrated with its SIGRAPH-EL product line.

General Electric Aerospace, Thompson-CFS, Thorn EMI

Siemens, General Electric Aerospace, Thompson-CFS, and Thorn EMI signed a memorandum of understanding establishing a consortium known as Euro-Art. The consortium will develop an advanced ground-based weapons-locating radar for the armed forces of France, Germany, and the United Kingdom.

MAP Deutschland

Siemens and MAP Deutschland entered into a cross-licensing pact covering Siedcon connector and RV-100-4 transfer systems for the connectors. The products are produced by the Electromechanical Component Divisions of the respective companies with Siemens manufacturing the connectors and MAP producing the transfer system.

Rational

Siemens and Rational are to cooperate on the Ada programming language for computer-aided software engineering (CASE). The move is intended to help both companies expand in the CASE sector.

Corning

Siemens and Corning have agreed to jointly develop passive fiber-optic transmission components that will help bring optical communications technology to the home.

1988 to 1989

MIPS Corporation

Siemens bought MIPS' design for the newest 32-bit RISC microprocessor.

BASF (Comparex)

BASF agreed to manage Siemens' IBM-compatible, non-Fujitsu-based mainframes.

Iskra

The companies are manufacturing telecom equipment (EWSD).

ROLM Systems

Siemens acquired this telecom product marketing and servicing company.

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Advanced Integrated Circuit Design Aids (AIDA)
AIDA is developing semiconductor technology.

AMD
The companies are developing a common chipsets for ISDN. AMD second sources Siemens' 80515 and 82258 DM A controllers.

JESSI
Siemens participates in JESSI to develop semiconductor technology with Philips and Thomson.

Megaproject
Siemens is developing DRAMs and SRAMs with Philips.

Open Software Foundation (OSF)
Siemens joined this UNIX development standards group.

Toshiba and General Electric
The companies are participating in the development of standard cell libraries.

Acer
The companies have an OEM agreement to resell the industrial PC 16-05.

Apollo
The companies have an OEM agreement covering the bottom end of midrange computers.

Fujitsu
The companies have an OEM agreement to resell the MX500 processor and VP Series of vector processors.

NEC
The companies have an OEM agreement to resell the NEAX2400 PBX.

Sequent
The companies have an OEM agreement to resell UNIX equipment and products.

Taylorix
Siemens manufactures PCs for resale.

Toshiba
Siemens is licensed to manufacture 1.2-micron CMOS 1Mb DRAMs.

Zenith
The companies have an OEM agreement to resell 80286-based laptops.

MERGERS AND ACQUISITIONS

1991

Anlagenbau Teltow
Siemens confirmed that it will buy Anlagenbau Teltow, the Berlin-based electrical components manufacturer.

Cardion Electronics Inc.
Siemens acquired Cardion Electronics Inc. from Ferranti International of England. The company manufactures and markets commercial and defense electronic navigation systems. The new name of the company is Cardion Inc.

EG&G Inc.
EG&G Inc. of Wellesley, Massachussetts, signed a letter of intent to acquire a majority interest in Heimann, subsidiary of Siemens AG. Heimann GmbH is a producer of optoelectronic devices based in Wiesbaden, Germany.

Ferranti Business Communications
Ferranti Business Communication was acquired by Siemens. Siemens will relocate the firm to its new site in Manchester.

GPT
Siemens Communications Systems and GPT Sales and Services, the largest UK telecommunications manufacturer, have agreed to merge their British distribution companies for computerized switchboards. Siemens and GEC will each indirectly own 17 percent of the venture directly with the remainder coming through its 40 percent stake of GPT. The venture will be financially consolidated into GPT, which will own 83 percent.

Relcon
Relcon, producer of electronic drive systems, has been acquired by ASI, a Siemens division that is involved in drive and switchboard technology. Via Relcon products, Siemens aims to increase it presence in the electronic drive systems markets in the United States and Mexico.

Texas Instruments Inc.
Texas Instruments Inc. signed a letter of intent to sell its Industrial Controls unit to Siemens Corp. Included in the sale are TI's products, facilities equipment, and sales/support activities.

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1990

Dr.-Ing Rudolf Hell GmbH
Linotype AG acquired Dr.-Ing, parent company being Siemens. Siemens will be the largest shareholder, with 33 1/3 percent of the stock.

GPT Ltd.
GPT Ltd. and Siemens AG merged their U.S. operations. The new company is called Siemens Stromberg-Carlson. Siemens and GPT will each own 50 percent.

Mannesmann Tally GmbH
Siemens acquired Mannesmann, a computer printer manufacturer, and merged it into Siemens' Office Products Division. Mannesmann is now 51 percent owned by Mannesmann AG and 49 percent by Siemens AG.

Nixdorf Computer
Siemens AG acquired 78 percent of Nixdorf Computer. The new company, a majority-owned subsidiary of Siemens called Siemens-Nixdorf Informationssyteme AG, combines the Siemens data and information systems activities with those of Nixdorf.

1989

ROLM Company
Siemens acquired ROLM from IBM.

The Plessey Company
In partnership with Britain's General Electric Company (GEC), Siemens acquired The Plessey Company, an electronics firm based in Ilford, Essex, England.

1988

Allied Signal Inc.
Siemens AG acquired Bendix Electronics Group from Allied Signal Inc. to strengthen its position in the automotive electronics market.

KEY OFFICERS

Karlheinz Kaske, Dr.-Ing.
President and CEO

Karl-Hermann Baumann, Dr.rer.oec.
Executive vice president, Corporate Finance

Heinrich von Pierer, Dr. jur.
Vice chairman

Hermann Franz
Executive vice president, Corporate Planning and Development

Claus Kessler, Dr.-Ing
Executive vice president, Corporate Production and Logistics

Hans-Gerd Neglein
Executive vice president, regional administrator

Hans Baur, Dr.-Ing
Executive vice president

Klaus Barthelt, Dr.-Ing.E.h.
Executive vice president

Horst Langer, Dr.-Ing
Executive vice president

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Information is not available.

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Table 3
Balance Sheet
Fiscal Year Ending September 30
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash*	0	0	0	0	00
Receivables	6,644.2	8,141.1	8,858.4	10,206.5	11,907.0
Marketable Securities	NA	NA	NA	10,364.5	9,743.1
Inventory	1,119.4	1,009.4	2,200.6	3,663.6	4,542.9
Other Current Assets	10,013.8	12,805.6	13,465.2	963.0	2,304.8
Total Current Assets	17,777.4	21,956.1	24,524.2	25,197.7	28,497.8
Net Property, Plants	5,701.4	7,467.2	7,653.4	7,394.3	8,978.9
Other Assets	741.5	1,067.8	1,315.2	1,661.4	2,554.3
Total Assets	24,220.3	30,491.1	33,492.7	34,253.3	40,031.1
Total Current Liabilities	1,914.9	1,958.9	2,193.5	2,248.3	2,520.6
Long-Term Debt	11,088.0	14,334.1	16,021.7	16,388.5	19,773.7
Other Liabilities	3,955.3	5,139.6	5,370.9	5,747.7	6,831.7
Total Liabilities	16,958.2	21,432.6	23,586.1	24,384.4	29,126.0
Converted Preferred Stock	21.3	25.7	26.0	24.6	28.7
Common Stock	1,085.5	1,324.4	1,349.0	1,299.8	1,591.4
Other Equity*	2,690.0	3,348.0	3,445.4	3,471.6	4,590.7
Retained Earnings	3,465.3	4,360.4	5,086.2	5,072.8	4,694.2
Total Shareholders' Equity	7,262.0	9,058.5	9,906.6	9,868.9	10,905.1
Total Liabilities and Shareholders' Equity	24,220.3	30,491.1	33,492.7	34,253.3	40,031.1
Exchange Rate (U.S.$1=DM)	2.17	1.80	1.78	1.88	1.61

*Other capital is paid-in capital.
NA = Not available

Source: Siemens AG
Annual Reports and Forms 10-K
Dataquest (November 1991)

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Table 4
Consolidated Income Statement
Fiscal Year Ending September 30
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	21,669.6	28,572.8	33,356.2	32,514.9	39,245.3
Domestic	10,184.3	13,896.1	17,278.1	15,132.4	17,609.9
International	11,485.3	14,676.7	16,111.8	17,382.4	21,635.4
Cost of Sales	25,508.3	20,478.9	23,552.8	13,409.6	16,618.0
R&D Expense	2,488.9	3,450.6	3,640.4	3,656.9	4,335.4
SG&A Expense	9,807.1	12,715.5	13,397.3	13,778.8	16,762.8
Capital Expense	3,155.8	2,951.7	2,927.0	4,187.4	4,388.8
Pretax Income	1,245.6	1,443.3	1,390.4	1,482.8	1,753.5
Pretax Margin (%)	5.75	5.05	4.17	4.56	4.47
Effective Tax Rate (%)	46.00	50.00	44.00	43.00	43.00
Net Income	679.3	708.3	718.5	838.8	1,036.0
Shares Outstanding, Millions	48.0	48.6	48.9	49.8	52.2
Per Share Data					
Earnings	14.01	13.94	15.11	15.74	18.45
Dividend	5.53	6.11	6.18	6.65	8.07
Book Value	143.59	177.56	193.48	190.74	199.94
Exchange Rate (U.S.$1=DM)	2.17	1.80	1.78	1.88	1.61

Source: Siemens AG
Annual Reports and Forms 10-K
Dataquest (November 1991)

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Table 5
Balance Sheet
Fiscal Year Ending September 30
(Millions of Deutsche Marks)

Balance Sheet	1986	1987	1988	1989	1990
Cash*	0	0	0	0	0
Receivables	14,418.0	14,654.0	15,768.0	19,188.2	19,170.3
Marketable Securities	0	0	0	19,485.3	15,686.4
Inventory	2,429.0	1,817.0	3,917.0	6,887.6	7,314.1
Other Current Assets	21,730.0	23,050.0	23,968.0	1,810.5	3,710.7
Total Current Assets	38,577.0	23,050.0	43,653.0	47,371.6	45,881.5
Net Property, Plants	12,372.0	39,521.0	13,623.0	13,901.2	14,456.1
Other Assets	1,609.0	1,922.0	2,341.0	3,123.4	4,112.4
Total Assets	52,558.0	54,884.0	59,617.0	64,396.2	64,450.0
Total Current Liabilities	4,155.4	3,526.1	3,904.5	4,226.8	4,058.1
Long-Term Debt	24,060.9	25,801.3	28,518.6	30,810.3	31,835.7
Other Liabilities	8,583.0	9,251.3	9,560.2	10,805.6	10,999.0
Total Liabilities	36,799.4	38,578.7	41,983.3	45,842.7	46,892.8
Converted Preferred Stock	46.2	46.2	46.2	46.2	46.2
Common Stock	2,355.5	2,383.9	2,401.2	2,443.7	2,562.2
Other Equity*	5,837.3	6,026.4	6,132.9	6,526.7	7,391.1
Retained Earnings	7,519.6	7,848.8	9,053.4	9,536.9	7,557.7
Total Shareholders' Equity	15,758.6	16,305.3	17,633.7	18,553.5	17,557.2
Total Liabilities and Shareholders' Equity	52,558.0	54,884.0	59,617.0	64,396.2	64,450.0
Exchange Rate (U.S.$1=DM)	2.17	1.80	1.78	1.88	1.61

*Other capital is paid-in capital.

Source: Siemens AG
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Dataquest (November 1991)

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Table 6
Consolidated Income Statement
Fiscal Year Ending September 30
(Millions of Deutsche Marks, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	47,023.0	51,431.0	59,374.0	61,128.0	63,185.0
Domestic	22,100.0	25,013.0	30,755.0	28,449.0	28,352.0
International	24,923.0	26,418.0	28,679.0	32,679.0	34,833.0
Cost of Sales	55,353.0	36,862.0	41,924.0	25,210.8	26,754.9
R&D Expense	5,401.0	6,211.0	6,480.0	6,875.0	6,980.0
SG&A Expense	21,281.3	22,887.9	23,847.2	25,904.2	26,988.1
Capital Expense	6,848.0	5,313.0	5,210.0	7,872.4	7,066.0
Pretax Income	2,703.0	2,598.0	2,475.0	2,787.6	2,823.1
Pretax Margin (%)	5.7	5.1	4.2	4.6	4.5
Effective Tax Rate (%)	46.00	50.00	44.00	43.00	0
Net Income	1,474.0	1,275.0	1,391.0	1,577.0	1,668.0
Shares Outstanding, Millions	48.0	48.6	48.9	49.8	52.2
Per Share Data					
Earnings	30.40	25.10	26.90	29.60	29.70
Dividend	12.00	11.00	11.00	12.50	13.00
Book Value	311.60	319.60	344.40	358.60	321.90
Exchange Rate (U.S.$1=DM)	2.17	1.8	1.78	1.88	1.61

Source: Siemens AG
Annual Reports and Forms 10-K
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Table 7
Key Financial Ratios
Fiscal Year Ending September 30

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	9.28	11.21	11.18	11.21	11.31
Total Assets/Equity (%)	333.52	336.60	338.09	347.08	367.09
Current Liabilities/Equity (%)	26.37	21.63	22.14	22.78	23.11
Total Liabilities/Equity (%)	233.52	236.60	238.09	247.78	26.09
Profitability (%)					
Return on Assets	0.06	0.04	0.04	0.05	0.04
Return on Equity	0.09	0.08	0.08	0.08	0.10
Profit Margin	3.13	2.48	2.34	2.58	2.64
Other Key Ratios					
R&D Spending % of Revenue	11.49	12.08	10.91	11.25	11.05
Capital Spending % of Revenue	14.56	10.33	8.77	12.88	11.18
Employees	359,000	359,000	353,000	365,000	373,000
Revenue (DM K)/Employee	130.98	143.26	168.20	167.47	169.40
Capital Spending % of Assets	28.27	17.42	15.56	22.98	17.65
Exchange Rate (U.S.$1=DM)		2.17	1.8	1.78	1.88

Source: Siemens AG
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Sony Corporation

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Shinagawa-ku
Tokyo 141, Japan
Telephone: (03) 448-2111
Fax: (03) 448-2244
Dun's Number: 04-065-3636

Date Founded: 1946

CORPORATE STRATEGIC DIRECTION

Sony Corporation, founded in Tokyo in 1946, is one of the world's leading manufacturers of video and audio equipment, televisions, displays, semiconductors, computers, computer peripherals, factory automation equipment, and engineering workstations.

Sony's business philosophy is to provide innovative and attractive products to its customers worldwide. Sony is one of Japan's leaders in global marketing; it had ¥3.6 trillion (U.S.$25.6 billion) in revenue for the fiscal year ended March 31, 1991. Because of its strong international customer base, the company is especially susceptible to fluctuations in international trade markets. The Gulf War, which occurred during fiscal 1991, had severe repercussions in the world economy and directly affected Sony's performance. The United States entered a recession in the second half of the year, the European economy evidenced sluggish performance, and the Japanese economy faced higher interest rates. Even with this difficult environment, Sony attained the highest sales and profit figures in the company's history. Sony points to strong growth in its electronics and entertainment industries as the key factors in its growth.

Sony's long-term strategy to improve product performance and meet customer expectations includes the following policies:

- In consumer electronics, Sony will strive to accelerate the development and marketing of attractive and original products. Expansion will occur in such areas as high-definition television (HDTV) products and information-related equipment for the home.
- In industrial electronics, Sony will seek to strengthen its operations in broadcast- and professional-use videocassette recorders and players (VTRs) and displays while addressing a varied spectrum of market needs. Other areas of targeted growth include recording media, semiconductors, electronic components, computer systems, information processing, and telecommunications.
- Sony will intensify its activities in the entertainment field by strengthening its music and image-based software operations, and by creating synergy with its electronics business. Efforts will be centered on Sony Music Entertainment Inc. (known before January 1, 1991, as CBS Records Inc.) and Columbia Pictures Entertainment Inc.
- Sony has committed to a companywide efficiency upgrade in all areas of business, as well as to the promotion of more efficient allocation of the company's capital, personnel, and management resources.
- Sony will seek to bring all facets of its overseas operations, including procurement of components, R&D, production, and marketing, in closer contact with local communities.

Sony's ¥3.6 trillion (U.S.$25.6 billion) total revenue for the year ended March 31, 1991, represents an increase of 27.11 percent over the year ended March 31, 1990. The increase in sales was led by a 178.4 percent increase in filmed entertainment revenue. Television sales increased 33.2 percent, video equipment sales grew 23.7 percent, and audio equipment sales increased 23.5 percent. Growth of 30.6 percent in the other products group can be attributed to the strong growth of information-related equipment. (Percentage changes refer to U.S. dollar amounts.)

Sony is an international company with 26.3 percent of its sales occurring in Japan, 29.2 percent in the United States, 28.1 in Europe, and 16.4 percent in all other regions. Europe posted the highest growth rate, increasing sales 43.9 percent, while the United States grew 24.4 percent and other international markets grew 37.3 percent. The Japanese market grew at a significantly lower rate of 10.9 percent.

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Net income increased 13.7 percent to ¥116.9 billion (U.S.$829.3 million) in fiscal year 1991 from ¥102.8 billion (U.S.$654.8 million) for fiscal 1990. Sony employed approximately 112,900 people in 1990, an increase of 18.1 percent over the 1990 year-end total of 95,600 employees.

R&D expenditure increased 24.6 percent to ¥205.8 billion (U.S.$1.2 billion) for the year ended March 31, 1991, from ¥165.2 billion (U.S.$1.2 billion) in the year ended March 31, 1990. R&D represented 5.7 percent of revenue for the year ended March 31, 1991. Capital expenditure for the year ended March 31, 1991, increased 27.1 percent from the previous year's ¥323.8 billion (U.S.$2.3 billion) to ¥411.7 billion (U.S.$2.9 billion), representing 11.4 percent of total revenue. The increased expenditure primarily was used for expanding production facilities for semiconductors; image-based devices such as color picture tubes; magnetic products; and audio and video equipment. About 35 percent of the capital development expenses were appropriated for overseas facilities. Sony intends to maintain a high level of capital investment and expects next year's expenditure to exceed this year's figure.

Sony's policy is to base its manufacturing operations in markets where its products are sold. By doing this, Sony brings its products closer to customers and avoids trade problems and exchange rate variations. Accordingly, Sony maintains its principal manufacturing facilities in Japan, the United States, and Europe.

In January 1991, Sony Music Entertainment Inc. (SMEI) and a subsidiary of Time-Warner Inc. formed The Columbia House Company, a 50:50 partnership consisting of the former Columbia House Division of SMEI. Columbia House is a direct marketer of music and home video products in the United States and Canada.

In November 1989, Sony purchased Columbia Pictures Entertainment, adding image-based software to its software business. This purchase emphasized strengthening of the company's software operations primarily through the record and video business.

On January 5, 1988, Sony purchased CBS Records Inc. and now holds 100 percent of the shares. The U.S.$2 billion (¥256.5 billion) acquisition was based on Sony's belief in the important relationship between the software and hardware sides of the consumer electronics business.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 7 at the end of this backgrounder present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Lines of Business

Video Equipment

The video equipment product group revenue totaled ¥908 billion (U.S.$6.4 billion) for the year ended March 31, 1991, or 25.1 percent of sales. Products include VTRs, video cameras, camcorder systems, videotapes, optical videodisk players, and high-definition video systems.

Audio Equipment

The audio equipment product group revenue totaled ¥883 billion (U.S.$6.2 billion) for the year ended March 31, 1991, or 24.4 percent of total sales. Products include tape recorders, audiotapes, cassette players, car stereos, amplifiers, tuners, turntables, speaker systems, CD players, digital audiotape (DAT) recorders, headphones, microphones, and compact discs.

Music Entertainment

Sony's music entertainment business reported revenue of ¥474 billion (U.S.$3.4 billion) for the year ended March 31, 1991, or 13.1 percent of total revenue. Performers on the Sony label include Mariah Carey, New Kids on the Block, George Michael, Billy Joel, Michael Bolton, Gloria Estefan, the Vaughan Brothers, and Harry Connick, Jr.

TV Equipment

Sony's television product group reported revenue of ¥553.4 billion (U.S.$3.9 billion) for the year ended March 31, 1991, or 15.3 percent of total revenue. Key products include color TVs and monitors, projection TVs, JumboTRON, direct broadcasting satellite reception systems, and security systems.

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Filmed Entertainment

Sony's filmed entertainment reported revenue of ¥257 billion (U.S.$1.8 billion), or 7.1 percent of sales for the year ended March 31, 1991. Fiscal 1991 film releases included *Total Recall, Look Who's Talking Too, Misery, Awakenings, Postcards from the Edge,* and *Flatliners.*

Other Products

The groups producing other products reported revenue of ¥543 billion (U.S.$3.8 billion) for the year ended March 31, 1991. Key products include the 3.5-inch microfloppy disk systems, microcomputers, workstations, CD-ROM systems, information processing systems, semiconductor devices, electronic components, dictating machines, word processors, induction cooking ranges, telephones, telecommunications systems, factory automation systems, batteries, accessories, and audio and video software.

Company Positioning

Computer Storage

Sony was one of the leading flexible disk drive (FDD) vendors in 1990. Dataquest estimates that Sony maintained its market leadership in the worldwide 3.5-inch FDD market with a 25 percent market share and $226.5 million in factory revenue. We estimate that Sony shipped 5 million 3.5-inch disk drives in 1989. In the worldwide overall FDD (3.5-inch and 5.25-inch) market, Sony dropped from third in 1989 to fourth in 1990, with a market share of 13.6 percent. Sony continues to emphasize the 3.5-inch market, beginning production of 3.5-inch drives in Malaysia in May 1990.

According to Dataquest estimates, Sony ranked first in the optical disk drive market in 1990 with $125.6 million in factory revenue and a 36.2 percent market share. Sony dominates the rewritable market in optical disk drives with 49.0 percent of the market, 39,200 units shipped, and $49 million in factory revenue. Sony also moved up to second in the 12-inch write-once, read-many (WORM) drive market with a 29.9 percent market share and $19.4 million in factory revenue.

Sony has entered the 3.5-inch rigid disk drive market. Dataquest expects Sony to offer a broad range of rigid drives with capacities between 40MB and 200MB and access times of less than 20ms.

Workstations

Sony Microsystems was formed in February 1988 to market Sony's NEWS workstation, a 32-bit UNIX workstation designed primarily for software development applications. Dataquest estimates that Sony had 6.6 percent of the worldwide workstation market share for calendar 1989. Dataquest estimates that Sony ranked fourth in the entry-level workstation market with U.S.$137.2 million in factory revenue for 1989. Dataquest also estimates that Sony ranked third in the Japanese workstation market, with a 9.8 percent market share and $133.7 million in factory revenue.

In May 1990, Sony introduced its laptop NEWS workstation to the European market and later to the Japanese market. Sony had two major design goals for its new workstation, as follows:

- The same level of performance and functionality as the NEWS desktop workstation
- Compatibility with NEWS software and hardware products

The laptop workstation is priced between $10,000 and $15,000 and is targeted toward the technical user with a requirement for a transportable, fully functional technical workstation.

In 1989, Sony introduced a RISC-based workstation using MIPS R3000 processors. Sony expanded its NEWS line to include lower-priced models, and high-performance 32-bit CPU versions. Sony added desktop publishing software to the NEWS line of workstations.

Personal Computers

In July 1991, Sony released a new PalmTop series of personal computers, featuring the ability to input characters with a light pen. The PTC-300, weighing in at 355g, offers significant improvements in portability. Sony does not market its computers in the United States and held less than 1 percent of the worldwide PC market, according to Dataquest estimates.

Semiconductors

Sony began marketing semiconductors in 1984 and currently produces a range of devices, including static random-access memory (SRAM) chips, charge-coupled devices (CCDs), and bipolar ICs for consumer audiovisual equipment. In capital expansion, Sony completed a new wing at Sony Nagasaki Corporation with a clean room for the manufacture of

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SRAMs and other leading-edge semiconductor devices and a design center for large-scale integration (LSI) technologies. In addition, Sony began operations at its first overseas semiconductor manufacturing facility, Sony Semiconductor (Thailand) Company Ltd., which will center on the assembly of bipolar ICs.

In the area of research and development, Sony announced in October 1990 the successful development of the world's fastest large-scale gallium arsenide gate array. The device will be used in workstations, image-processing equipment, and other equipment requiring high-speed data processing capabilities.

Dataquest estimates that Sony's 1990 worldwide semiconductor market share was 1.9 percent, with U.S.$1.1 billion in revenue. Dataquest estimates that Sony ranks 19th in the total worldwide semiconductor market, while in Japan, Sony ranked 9th for the third year in a row, with a 4.0 percent market share. Japan represented 77.7 percent of Sony's semiconductor revenue for 1990.

Computer Software

Sony Computer Science Laboratory Inc. was established by Sony Corporation to develop distributed operating systems, programming languages, system architectures, and user interfaces.

Further Information

For further information about the company's business segments, please contact the appropriate Dataquest industry services.

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Table 1
Five-Year Corporate Highlights (Billions of U.S. Dollars)

	1987	1988	1989	1990	1991
Five-Year Revenue	3.4	10.4	16.7	20.1	25.6
Percent Change	-42.67	202.02	41.94	20.84	27.11
Capital Expenditure	0.6	1.0	1.7	2.3	2.9
Percent of Revenue	18.55	9.33	10.05	11.25	11.38
R&D Expenditure	0.8	0.9	1.1	1.2	1.5
Percent of Revenue	9.27	8.91	6.62	5.74	5.69
Number of Employees	47,583	71,000	78,900	95,600	112,900
Revenue (U.S.$K)/Employee	72.15	146.04	212.01	210.76	226.84
Net Income	0.1	0.3	0.6	0.7	0.8
Percent Change	-55.98	218.98	112.61	27.23	15.10
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

1991 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	5.41	6.23	7.84	6.34
Quarterly Profit	0.16	0.19	0.39	0.11

Source: Sony Corporation
Annual Reports
Dataquest (January 1992)

Table 2
Revenue by Geographic Region (Percent)

Region	1987	1988	1989	1990	1991
United States	27	28	27	30	29
Japan	35	35	34	30	26
Europe	24	23	23	25	28
All Other Regions	14	14	16	15	17

Source: Sony Corporation
Annual Reports
Dataquest (January 1992)

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1990 SALES OFFICE LOCATIONS (Includes sales subsidiaries only)

Asia/Pacific—19
International—14

MANUFACTURING LOCATIONS

North America

Digital Audio Disc (United States)
CDs
Sony Engineering and Manufacturing of America (United States)
TVs, CRTs, 32-bit workstations, 3.5-inch FDDs, CD-ROM drives, monitors, audio speakers, factory automation equipment
Sony Magnetic Products Inc. (United States)
Magnetic tapes, flexible disks
Sony Microelectronics Corporation (United States)
Semiconductors
Sony Music Entertainment (United States)
Phonograph records, tapes, CDs
Sony Professional Products Company (United States)
Professional AV equipment
Sony USA (United States)
Electronic equipment

Europe

DADC Austria (Austria)
CDs
Sony (United Kingdom)
TVs, CRTs
Sony Espana (Spain)
TVs, VCRs
Sony France (France)
CD players, video cameras, VHS video decks
Sony-Wega Productions (United Kingdom)
TVs
Television Division Europe (France)
Development, design of TVs

Asia/Pacific

Aiwa Company (Japan)
High-fidelity audio systems, headphone stereos
Hagiwara Electronics (Japan)
TV/video equipment
Mac Precision Products (Japan)
Precision parts
Miyagi Video-Tech (Japan)
Magnetic tapes
Motomiya Denshi (Japan)
Trinitron gun, security systems, flat display tubes, TV parts
Nakada Magnetics (Japan)
Ferrites
Sony Akebono Denshi (Japan)
Printed circuit boards
Sony Audio (Japan)
Audio, video, camera, and optical systems
Sony Bonson (Japan)
Tape recorders, flat TVs, radios
Sony Chemicals (Japan)
Magnetic tapes, chemical products
Sony Computer Science Lab (Japan)
R&D of computer systems/software
Sony Denshi (Japan)
TVs and parts
Sony Electronics (Japan)
Radiocassette tape recorders
Sony Ichinomiya (Japan)
VCRs, color TVs
Sony Inazawa (Japan)
Color CRTs
Sony Itakura (Japan)
CD players, radiocassette recorders
Sony Kisarazu (Japan)
VCRs, CD players
Sony Kohda (Japan)
Video equipment
Sony Kokubu Semiconductor (Japan)
Bipolar ICs, CCDs
Sony Magnescale (Japan)
Electronic measuring instruments
Sony Magnetic Products (Japan)
Magnetic tapes, ferrites, videotapes
Sony Minokama (Japan)
Video equipment
Sony Mizunami (Japan)
Color CRTs
Sony Nagasaki (Japan)
Semiconductors
Sony Oita (Japan)
Semiconductors
Sony Precision Engineering (Japan)
Precision parts for audio equipment for Sony's subsidiaries worldwide
Sony Semiconductor (Japan)
Bipolar ICs

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Sony Shiroishi Semiconductor (Japan)
Semiconductors
Sony Sound Tec (Japan)
Microphones, PA systems, furniture, hearing aids
Sony TV-Video (Japan)
Color TVs
Sony Tektronix (Japan)
Electronic measurements, displays, control instruments, computer graphics products
Sony Video Taiwan (Taiwan)
VCRs
Sound Magnetics (Japan)
Magnetic heads
Sound System (Japan)
VCRs, CD players
Taron Corporation (Japan)
Audio and video products
Tohkai Electronics (Japan)
PC boards
Toyo Radio (Japan)
Audio products
Video Magnetics (Japan)
Ferrites

ROW

Magneticos de Mexico (Mexico)
Magnetic tapes, floppy disks
Sony da Amazonia (Brazil)
VCRs
Sony de Venezuela (Venezuela)
Color TVs
Sony Videobras (Brazil)
Video cameras, video equipment
Videotec de Mexico (Mexico)
Video equipment

SUBSIDIARIES

As of March 31, 1991, Sony had 625 consolidated subsidiaries. The list below gives the company's principal subsidiaries and affiliated companies as of April 30, 1991.

North America

Digital Audio Disc Corporation (United States)
Materials Research Corporation (United States)
Sony Corporation of America (United States)
Sony Music Entertainment Inc. (United States)
Sony of Canada Ltd. (Canada)
Sony Pictures Entertainment (United States)
Sony Trans Com Systems Division (United States)
Sony USA Inc. (United States)

Europe

DADC Austria GesmbH (Austria)
Sony Belgium N.V. (Belgium)
Sony Broadcast & Communications Limited (United Kingdom)
Sony Communication Products B.V. (Netherlands)
Sony Deutschland GmbH (Germany)
Sony Espana S.A. (Spain)
Sony Euro-Finance B.V. (Netherlands)
Sony Europa GmbH (Germany)
Sony France S.A. (France)
Sony GesmbH (Austria)
Sony Italia S.p.A. (Italy)
Sony Nederland B.V. (Netherlands)
Sony Overseas S.A. (Switzerland)
Sony Portugal Lda. (Portugal)
Sony Scandinavia A/S (Denmark)
Sony (Schweiz) A.G. (Switzerland)
Sony Service Centre (Europe) N.V. (Belgium)
Sony (U.K.) Limited (United Kingdom)
Sony-Wega Productions GmbH (Germany)

Asia/Pacific

Aiwa Co. Ltd. (Japan)
Akebono Electronics Inc. (Japan)
CBS/Sony Group Inc. (Japan)
Hasso Electronics Corporation (Japan)
Korea Toyo Radio Co. Ltd. (South Korea)
Max Precision Products Corporation (Japan)
Motomiya Denshi Corporation (Japan)
Sony (Australia) Pty. Limited (Australia)
Sony Asco Inc. (Japan)
Sony Bonson Corporation (Japan)
Sony Broadcast Products Corporation (Japan)
Sony Chemicals Corporation (Japan)
Sony Corporation of Hong Kong Limited (Hong Kong)
Sony Creative Products Inc. (Japan)
Sony Denshi Corporation (Japan)
Sony Electronics (Malaysia) Sdn. Bhd. (Malaysia)
Sony Energytec Inc. (Japan)
Sony Engineering Corporation (Japan)
Sony Enterprise Co. Ltd. (Japan)
Sony Finance International Inc. (Japan)
Sony Ichinomiya Corporation (Japan)
Sony Inazawa Corporation (Japan)
Sony International (Singapore) Pte. Ltd. (Singapore)

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Sony Kisarazu Corporation (Japan)
Sony Kohda Corporation (Japan)
Sony Kokubu Semiconductor Corporation (Japan)
Sony Logistics (Singapore) Pte. Ltd. (Singapore)
Sony Logistics Corporation (Japan)
Sony Magnescale Inc. (Japan)
Sony Magnetic Products Inc. (Japan)
Sony Magnetic Products (Thailand)
Sony Magnetic Tape Sales Corporation (Japan)
Sony Minokamo Corporation (Japan)
Sony Mizunami Corporation (Japan)
Sony Nagasaki Corporation (Japan)
Sony Oita Corporation (Japan)
Sony PCL Inc. (Japan)
Sony Plaza Co. Ltd. (Japan)
Sony Precision Engineering Center (Singapore) Pte. Ltd. (Singapore)
Sony Procurement Service Corporation (Japan)
Sony Pruco Life Insurance Co. Ltd. (Japan)
Sony Service Co. Ltd. (Japan)
Sony Shiroishi Semiconductor Inc. (Japan)
Sony Shoji Corporation (Japan)
Sony Singapore Pte. Ltd. (Singapore)
Sony Sound Tec Corporation (Japan)
Sony TV Video (Malaysia) Sdn. Bhd. (Malaysia)
Sony Trading Corporation (Japan)
Sony Tsukuba Corporation (Japan)
Sony Video Taiwan Co. Ltd. (Taiwan)
Sony/Tektronix Corporation (Japan)
Sound System Corporation (Japan)
Taron Corporation (Japan)
Tohkai Electronics Corporation (Japan)

ROW

Magneticos de Mexico, S.A. de C.V. (Mexico)
Sony CSA, S.A. (Panama)
Sony Chile Ltda. (Chile)
Sony Corporation of Panama S.A. (Panama)
Sony da Amazonia Ltda. (Brazil)
Sony de Venezuela S.A. (Venezuela)
Sony Saudi Arabian Company Ltd. (Saudi Arabia)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Advanced Micro Devices Inc. (AMD)
Sony and AMD signed a broad patent and copyright cross-licensing agreement covering wafer processes, design, and architectures for integrated circuits.

Apple Computer Inc.
Sony will manufacture major portions of the laptop Macintosh computer under development by Apple.

Bell Microproducts Inc.
Bell added Sony's read-write optical drives to its current franchise list.

Digital Equipment Corporation
Digital and Sony entered an agreement through which Digital will produce optical subsystems based on Sony optical disk drives.

Matsushita Electric Industrial
Matsushita Electric Industrial and seven other companies (Kyushu Matsushita Electric, Sega Enterprises, Chinon Industries, Casio Computer, Ricoh, Canon, and Sanyo Electric) will make CD-ROMs based on Sony specifications.

Nihon Silicon Graphics K.K. (NSG)
Sony and NSG signed a marketing agreement in which Sony will market a high-definition computer graphics system for NSG's Iris 4-D Power Vision graphics workstation.

Ricoh Company
Ricoh will provide its Design Base Jr. three-dimensional model-generation software package to Sony to be bundled with Sony's new NWB-236 processor.

SGS-Thomson Microelectronics
SGS-Thomson Microelectronics will second-source a chip set for high-speed serial digital video transmission developed by Sony.

Software Toolworks
Sony and Software Toolworks signed a licensing agreement allowing Sony to use special versions of Software Toolworks' CD-ROM software with Sony's CD-ROM optical disk player.

VideoLogic Inc.
Sony signed an agreement with VideoLogic allowing Sony to sell multimedia products through computer resellers and video dealers.

Wave Front Technologies
Wave Front will supply Sony with its TPV computer graphics software, to be bundled with Sony's latest three-dimensional computer graphics board, the NWB-256.

1990

Exabyte Corporation
Exabyte renewed a supply agreement with Sony under which Sony will supply Exabyte with 5.25-inch form factor tape drives.

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Compression Labs Inc.
Sony entered into a reseller agreement with Compression Labs under which Sony will resell Compression Labs video coder/decoders. The agreement marks Sony's entry into the U.S. videoconferencing market.

Texas Instruments
Texas Instruments agreed to produce semiconductors in Europe for Sony on a consignment basis.

NJK Ltd.
NJK Ltd. signed as a distributor for Sony's NEWS workstations.

Fujitsu
Sony and Fujitsu jointly developed a trial common rule to develop CD-ROM XA software for their personal computers.

Oracle Corporation
Oracle agreed to supply the Oracle relational database management systems and applications development software products for the Sony NEWS family of UNIX workstations.

Novell K.K.
Novell K.K. was formed as a joint marketing venture to sell NetWare products in Japan. Novell and six partners—Canon, Fujitsu, NEC, Softbank, Sony, and Toshiba—helped fund the project.

Advanced Micro Devices (AMD)
AMD agreed to enter a joint manufacturing and educational pact with Sony to manufacture SRAMs.

Summus Computer Systems
Summus agreed to sell, distribute, and service 4mm DAT drives from Sony. Summus agreed to be an original equipment manufacturer (OEM) of Sony and to integrate hardware and software that offers turnkey storage subsystems for the Apple Macintosh, Digital, and Sun Microsystems Inc. PC markets.

1989

Parallex Graphics Inc.
Sony Microsystems agreed to incorporate Parallex's color graphics and video graphics controllers in Sony's workstations.

Matsushita Philips
Sony, Matsushita, and Philips agreed to develop, manufacture, and market interactive compact disk drives.

Apple Computer Inc.
Sony signed a contract with Apple to supply 40MB rigid disk drives for the Macintosh.

Hewlett-Packard Company (HP)
Sony agreed to supply 5.25-inch rewritable optical disk storage products to HP for the new HP C17QA Optical Disk Library System.

Pinnacle Micro
Sony announced plans to supply $1 million (¥128.3 million) worth of 5.25-inch rewritable optical disk storage products to Pinnacle Micro.

Advanced Micro Devices (AMD)
Sony and AMD entered a joint venture agreement for an SRAM memory product.

1988

Daewoo Electronics
Sony and Daewoo agreed to jointly develop 256K SRAMs, 64K SRAMs, 8- and 16-bit MPUs, and other microchips.

Engineering Mechanics Research (EMR)
Sony and EMR agreed to a joint venture in CAE software technology and sales. EMR is marketing Sony's engineering workstations (EWSs) that employ its software in the United States while Sony supports sales agents of EMR's software in Japan by supplying its EWS.

N.V. Philips Gloeilampenfabrieken
Sony and Philips agreed to a joint development of extended architecture CD-ROMs for audio use.

Motorola Inc.
Sony Microsystems agreed to incorporate dual Motorola 68030 MPUs in high-end models of Sony's NEWS UNIX workstation family.

Symbolics
Sony and Symbolics completed a sales agreement for Sony's workstations in the U.S. market. Sony Microsystems began supplying its workstations to Symbolics in May 1988 for sale in the United States under the Symbolics brand name. The two companies agreed to jointly develop a new model of workstation using Symbolics' A1 chips.

Texas Instruments Inc. (TI)
TI Japan and Sony jointly developed the CXD1144AP high-performance digital filter LSI for digital audio equipment.

Advanced Micro Devices (AMD)
Sony and AMD agreed to a sales tie-up for Sony's workstations in South Korea.

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MERGERS AND ACQUISITIONS

1991

National Broadcasting Company
Sony purchased NBC's 50 percent stake in RCA/Columbia Home Video, resulting in Sony's complete ownership of the company.

1989

Trans Com Systems Division
Sony purchased all assets and liabilities of Trans Com Systems, a division of Sundstrand Corporation. Trans Com designed, manufactured, and installed in-flight AV entertainment systems in commercial aircraft worldwide.

Materials Research Corporation (MRC)
Sony acquired all of the outstanding shares of common stock of MRC and its affiliates. MRC manufactured and supplied sputtering and etching equipment, high-purity metals, and ceramics.

Columbia Pictures Entertainment
Sony acquired all of the outstanding shares of common stock of Columbia Pictures, which was primarily in the filmmaking business.

Guber-Peters Entertainment Company (GPEC)
Sony acquired GPEC, which was in the filmmaking business.

1988

CBS Records Inc.
Sony purchased CBS Records for U.S.$2 billion (¥256.5 billion) and held 100 percent of the shares. (The acquisition was made using U.S. currency.)

KEY OFFICERS

Akio Morita
Chairman and representative director

Norio Ohga
President and chief executive officer

Masaaki Morita
Deputy president

Nobuo Kanoi
Deputy president

Ken Iwaki
Deputy president

Tsunao Hashimoto
Deputy president

PRINCIPAL INVESTORS

Information is not available

FOUNDERS

Masaru Ilsuka
Akio Morita

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Table 3
Balance Sheet
Fiscal Year Ending March 31
(Billions of U.S. Dollars)

Balance Sheet	1987*	1988	1989	1990	1991
Cash	1.0	1.6	2.3	3.2	3.1
Receivables	1.6	2.4	3.4	5.8	5.8
Marketable Securities	0.8	0.7	0.7	0.4	0.2
Inventory	1.9	2.4	3.8	4.8	5.2
Other Current Assets	0.5	0.7	1.0	1.2	1.5
Total Current Assets	5.8	7.8	11.2	15.4	15.8
Net Property, Plants	2.2	3.1	4.2	6.1	7.4
Other Assets	0.9	2.6	3.0	9.1	9.4
Total Assets	8.8	13.5	18.4	30.6	32.6
Total Current Liabilities	3.7	6.8	8.7	14.0	14.9
Long-Term Debt	0.9	1.4	1.7	4.5	4.9
Other Liabilities	0.5	0.6	0.8	2.0	2.3
Total Liabilities	5.0	8.8	11.2	20.5	22.1
Converted Preferred Stock	0	0	0	0	0
Common Stock	0.1	0.2	0.9	1.9	2.1
Other Equity	0.4	0.4	1.5	3.3	2.9
Retained Earnings	3.4	4.1	4.8	4.9	5.4
Total Shareholders' Equity	3.8	4.7	7.2	10.1	10.5
Total Liabilities and Shareholders' Equity	8.8	13.5	18.4	30.6	32.6
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

*For the five-month period ending March 31, 1987. Effective March 31, 1987, the parent company and almost all subsidiaries and affiliates changed their fiscal year-end from October 31 to March 31. Accordingly, the fiscal period ended March 31, 1987, included only 5 months of operations, whereas other fiscal years consisted of 12 months.

Source: Sony Corporation Annual Reports
Dataquest (January 1992)

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Table 4
Consolidated Income Statement
Fiscal Year Ending March 31
(Billions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1987*	1988	1989	1990	1991
Revenue	3.4	10.4	16.7	20.1	25.6
Japanese Revenue	1.1	3.5	5.7	6.1	6.7
Non-Japanese Revenue	2.3	6.9	11.0	14.1	18.9
Cost of Sales	2.6	7.7	11.5	13.6	17.7
R&D Expense	0.8	0.9	1.1	1.2	1.5
SG&A Expense	0.8	2.4	4.4	5.0	6.3
Capital Expense	0.6	1.0	1.7	2.3	2.9
Pretax Income	0.1	0.5	1.3	1.6	1.9
Pretax Margin (%)	4.36	5.14	7.71	7.90	7.32
Effective Tax Rate (%)	58.00	56.00	56.00	54.00	51.00
Net Income	0.1	0.3	0.6	0.7	0.8
Shares Outstanding, Thousands	231,236	238,769	282,603	331,929	338,593
Per Share Data					
Earnings	0.34	1.04	1.88	2.15	2.02
Dividend	0.12	0.32	0.28	0.32	0.32
Book Value	16.50	19.71	25.57	30.50	30.88
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

*For the five-month period ending March 31, 1987. Effective March 31, 1987, the parent company and almost all subsidiaries and affiliates changed their fiscal year-end from October 31 to March 31. Accordingly, the fiscal period ended March 31, 1987, included only 5 months of operations, whereas other fiscal years consisted of 12 months.

Source: Sony Corporation Annual Reports
Dataquest (January 1992)

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Table 5
Balance Sheet
Fiscal Year Ending March 31
(Billions of Yen)

Balance Sheet	1987*	1988	1989	1990	1991
Cash	152.9	218.0	297.9	451.7	442.9
Receivables	256.6	325.7	433.4	832.9	815.1
Marketable Securities	132.2	99.4	91.1	54.8	33.5
Inventory	302.9	334.7	483.7	693.0	731.7
Other Current Assets	77.6	99.1	127.7	169.2	211.2
Total Current Assets	922.2	1,076.9	1,433.8	2,201.6	2,234.4
Net Property, Plants	343.1	426.3	544.7	868.1	1,046.8
Other Assets	145.9	363.7	386.2	1,300.4	1,321.2
Total Assets	1,411.2	1,866.9	2,364.7	4,370.1	4,602.4
Total Current Liabilities	587.0	945.0	1,119.0	1,995.9	2,104.6
Long-Term Debt	143.4	196.0	220.8	646.0	694.5
Other Liabilities	72.1	76.3	98.2	281.3	327.0
Total Liabilities	802.5	1,217.3	1,438.0	2,923.2	3,126.1
Converted Preferred Stock	0	0	0	0	0
Common Stock	12.0	23.7	114.6	278.0	296.4
Other Equity	56.5	60.9	195.6	473.4	413.5
Retained Earnings	540.2	565.0	616.5	695.5	766.4
Total Shareholders' Equity	608.7	649.6	926.7	1,446.9	1,476.3
Total Liabilities and Shareholders' Equity	1,411.2	1,866.9	2,364.7	4,370.1	4,602.4
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Sony Corporation
Annual Reports
Dataquest (January 1992)

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Table 6
Consolidated Income Statement
Fiscal Year Ending March 31
(Billions of Yen, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	547.8	1,431.2	2,145.3	2,879.9	3,616.5
Japanese Revenue	177.5	479.4	731.3	869.5	952.5
Non-Japanese Revenue	370.3	951.8	1,414.0	2,010.4	2,664.0
Cost of Sales	407.8	1,064.6	1,475.4	1,938.0	2,505.6
R&D Expense	131.2	127.5	142.1	165.2	205.8
SG&A Expense	131.0	336.3	565.6	712.0	887.8
Capital Expense	101.6	133.5	215.6	324.0	411.7
Pretax Income	23.6	73.5	165.5	227.4	264.6
Pretax Margin (%)	4.36	5.14	7.71	7.90	7.32
Effective Tax Rate (%)	58.00	56.00	56.00	54.00	51.00
Net Income	13.3	36.7	72.5	102.8	116.9
Shares Outstanding, Thousands	231,236	238,769	282,603	331,929	338,593
Per Share Data					
Earnings	54.2	143.8	219.7	279.0	285.9
Dividend	18.5	44.6	40.5	45.5	45.5
Book Value	0	0	0	0	0
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

*For the five-month period ending March 31, 1987. Effective March 31, 1987, the parent company and almost all subsidiaries and affiliates changed their fiscal year-end from October 31 to March 31. Accordingly, the fiscal period ended March 31, 1987, included only 5 months of operations, whereas other fiscal years consisted of 12 months.

Source: Sony Corporation
Annual Reports
Dataquest (January 1992)

Table 7
Key Financial Ratios
Fiscal Year Ending March 31

Key Financial Ratios	1987	1988	1989	1990	1991
Liquidity					
Current (Times)	1.57	1.14	1.28	1.10	1.06
Total Assets/Equity (%)	231.85	287.39	255.17	302.03	311.75
Current Liabilities/Equity (%)	96.44	145.47	120.75	137.94	142.56
Total Liabilities/Equity (%)	131.84	187.39	155.17	202.03	211.75
Profitability (%)					
Return on Assets	0.94	2.24	3.43	3.05	2.23
Return on Equity	2.19	5.83	9.20	8.66	6.96
Profit Margin	2.43	2.56	3.38	3.57	2.84
Other Key Ratios					
R&D Spending % of Revenue	23.95	8.91	6.62	5.74	4.57
Capital Spending % of Revenue	18.55	9.33	10.05	11.25	8.96
Employees	47,583	71,000	78,900	95,600	112,900
Revenue (¥M)/Employee	11.51	20.16	27.19	30.12	32.03
Capital Spending % of Assets	7.20	7.15	9.12	7.41	7.04
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Sony Corporation
Annual Reports
Dataquest (January 1992)

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Texas Instruments Incorporated

13500 N. Central Expressway
P.O. Box 655474
Dallas, Texas 75265
Telephone: (214) 995-2011
Fax: (214) 995-4360
Dun's Number: 00-732-1904

Date Founded: 1930

CORPORATE STRATEGIC DIRECTION

Texas Instruments Incorporated (TI) develops, manufactures, and markets a variety of electronic products for the industrial, government, and consumer markets. These products consist of components, defense electronics, and digital products. The company also produces metallurgical materials. TI's business is based principally on its broad semiconductor technology and on the application of this technology to selected electronic end-equipment markets. Founded in 1930, the company has an impressive record of industry firsts, ranging from the co-invention of the first integrated circuit (IC) to the first hand-held electronic calculator. In addition, TI has been a pioneer in speech synthesis.

TI's components segment consists of semiconductor integrated circuits, semiconductor discrete devices, semiconductor subassemblies, and electrical and electronic control devices. Texas Instruments sells these components primarily to original equipment manufacturers (OEMs) through its own marketing organizations and, to a lesser extent, through distributors. In 1990, components accounted for 48 percent of the company's total revenue.

Defense electronics consists of radar systems, navigation systems, infrared surveillance and fire control systems, defense suppression missiles, other weapon systems, missile guidance and control systems, electronic warfare systems, and other defense electronic equipment. Sales are made primarily to the U.S. government either directly or through prime contractors. Defense electronics accounted for 33 percent of company sales during 1990.

The company's digital products segment includes multiuser minicomputers, personal computers and workstations, software development tools, electronic data terminals and printers, industrial automation and control systems, electronic calculators, and learning aids. Digital products are used in a broad range of standalone and distributed network computing applications. TI markets these digital products through multiple channels, including systems suppliers, business equipment dealers, distributors, retailers, and direct sales to OEMs and end users. Digital products accounted for 19 percent of total revenue.

Metallurgical materials include clad metals, precision-engineered parts, and electronic connectors for use in a variety of applications such as appliances, automobiles, electronic components, and industrial and telecommunications equipment. These metallurgical materials are primarily sold directly to OEMs. This segment accounted for 2 percent of sales in 1990.

TI's fiscal year 1990 net revenue was $6.57 billion*, approximately even with 1989 results. The company reported a net loss of $39 million, compared with net income of $292 million in 1989. Losses in TI's semiconductor business, stemming from sharply lower memory prices and substantially higher investments in new products and capacity, were a main reason for the unfavorable changes in operating results. Margins in the company's defense electronics business were down slightly on relatively stable revenue, and losses were reduced in TI's new information technology business unit. Profitability declined in the materials and controls business, reflecting the weakness of the U.S. economy and increased investments. Capital expenditure rose to $909 million, representing 13.8 percent of revenue. The increase was primarily for new submicron CMOS wafer-fabrication facilitites in the components segment. R&D expenditure increased slightly to $540 million from $506 million in 1989. The company employs 70,318 people worldwide.

*All dollar amounts are in U.S. dollars

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More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 6 present comprehensive financial information at the end of this backgrounder.

BUSINESS SEGMENT STRATEGIC DIRECTION

Semiconductors

According to Dataquest, TI ranked as the seventh-largest semiconductor company worldwide in 1990, with a 4.4 percent market share based on estimated factory revenue of $2.57 billion. TI is one of the world's broadest-range semiconductor manufacturers and offers products ranging from bipolar logic devices to gate arrays and advanced microprocessors. In the worldwide MOS microcomponents market, the company held a 3.2 percent market share based on estimated factory revenue of $320 million. Texas Instruments is among the leaders in bipolar logic integrated circuits and is also strong in linear and memory products. In addition, the company is a major supplier of 256K and 1Mb DRAMs. In 1990, TI rose to number eight in rank in the worldwide MOS logic market, with factory reveue of $306 million and a 3.4 percent market share. In the analog market, Dataquest estimates that TI ranked seventh, with factory revenue of $458 million and a 4.3 percent market share. In the MOS memory market, TI also ranked seventh with 95.7 percent market share based on an estimated $741 million in factory revenue.

TI is continuing to shift its product mix toward a greater percentage of differentiated semiconductor products such as application-specific integrated circuits (ASICs), applications processors, microcontrollers, advanced linear circuits, and differentiated memory products. The company achieved double-digit revenue growth in differentiated products in 1990 and has increased its semiconductor marketing resources to support these products.

Texas Instruments has recently made a large effort to increase capacity for submicron CMOS wafer fabrication. By 1992, TI will have submicron CMOS wafer fab facilities strategically located in the world's four major semiconductor markets—Japan, the United States, Europe, and the Asia-Pacific region. This capacity will represent a fourfold increase in submicron CMOS wafer starts over TI's capacity at the beginning of 1990. In early 1991, TI announced its new TGB1000 family of seven gate array products, which use new BiCMOS technology to achieve both high component densities and high speeds. The most notable product in the TGB1000 family is a gate array chip with 150,000 gates; it is expected to be used in telephone systems and computer workstations.

During 1990, TI began ramping up production of its 4Mb DRAMs in Miho, Japan, and pilot processing of 4MB DRAM wafers at its new facility in Avezzano, Italy. In addition, the TI/Acer Laboratories facility in Taiwan, expected to come on-line during 1991, will be used initially to produce 4MB DRAMs. Texas Insturments also began limited sampling of its 16MB DRAMs, manufactured at the company's submicron prototyping line in Dallas, Texas, and is proceeding on design work of its 64MB DRAMs.

Defense

Texas Instruments has supplied state-of-the-art defense electronics systems to the U.S. Department of Defense (DOD) and U.S. allies for more than 40 years. In defense electronics, the company's goal is to align the cost structure of this business with the reduced level of revenue expected in the future, and then to drive for market share gains in selected growth areas. TI is building on its technical base to strengthen its position in electro-optical sensors, antiarmor weapons, and airborne fire-control radars. Several key development programs, with the potential to be high-volume programs in the future, are in important markets for TI, including next-generation antitank weapons, solid-state phased-array radars, and intelligent weapons systems.

The high-speed antiradiation missile (HARM) continues to be the keystone of TI's weapons systems business. The HARM counteracts surface-to-air missiles by neutralizing their ground-based radar systems. Since production of the HARM began in 1982, the unit price has come down by a factor of more than two over that period. During 1991, TI will launch a major upgrade to this program; primary clients are the U.S. Navy and Air Force.

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During 1990, Texas Instruments redesigned the F-111 terrain-following radar (TFR) for the air force to extend the life of the TFR beyond the year 2000. The system has a mean time between failure that exceeds specification by a factor of more than two, so it can be ready when needed. The company's APS-137 family of ocean surveillance and control radars provides over-the-horizon ship-classification and targeting capability through the use of inverse synthetic aperature radar (ISAR) processing to create a target image that can be classified from beyond visual range. TI's high-speed digital gallium arsenide components will be used to provide improved ISAR capability in the 1990s. For the U.S. army, TI is applying "fire-and-forget" guidance, now under development on the advanced antitank weapon system-medium (AAWS-M). This system meets the need for a portable weapon that provides greatly increased gunner safety.

Information Technology

The mission of the Information Technology Group (ITG), established in 1989, is to provide cost-effective technologies that help customers gain significant competitive advantage from the timely, effective use of information. Products in this group include integrated computer-aided software engineering (CASE) tools, multiuser computer systems using the UNIX operating system, portable personal computers, printers, industrial automation systems, and custom manufacturing services.

TI's Information Engineering Facility (IEF) product is an integrated CASE tool that allows application developers to design business systems using graphical models that describe business operations and to automatically generate business systems from those models. In mid-1990, the company began shipping IEF software products for the IBM OS/2, IBM's multitasking operating system for workstations. The IEF for OS/2 includes Planning, Analysis, Design, and a new workstation tool set called Construction (or PC code generation). TI is in the process of broadening the applicability of IEF to include Digital Equipment Corporation, Tandem, and UNIX environments in addition to IBM environments.

The most recent addition to TI's UNIX-based 1500 computer family of multiuser systems is the 25-MHz model 1507. The model 1507, which handles up to 64 active users, is a 68040-based version of the TI single-processor model 1505 and is binary compatible with the complete line of 1500 Series computers.

Texas Instruments has seen dramatic growth in its printers and portable computers as it continues to expand its product lines and distribution channels. The TravelMate 3000, TI's most recent notebook PC, features a 20-MHz Intel 80386SX processor, a 10-inch diagonal black-on-white VGA display, and a 1.44MB floppy and 20MB hard disk drive. The TravelMate 3000 is aimed at users that require the utmost in portability with the power requirements found in a 386SX PC. The company also manufactures a broad range of printers including the MicroLaser 35, a PostScript laser printer that comes with 35 fonts and 1.5MB of RAM (expandable to 4.5MB), and the MicroLaser XL, a personal-size 16-page-per-minute printer that comes with Hewlett-Packard LaserJet Series II emulation.

Manufacturers use TI industrial automation products and systems to monitor and refine their manufacturing processes. New products in this area announced in 1990 include the TI545 programmable logic controller (PLC) and the PLC-on-a-chip, which dramatically reduces size and cost and improves performance of the company's low-end PLCs. In April 1991, TI signed a letter of intent with Siemens Corporation, a wholly owned subsidiary of Siemens AG, for Siemens to acquire TI's Johnson City, Tennessee-based industrial controls business. This business unit designs, manufactures, and markets PLCs and related products. Included in this proposed transaction would be TI's products, facilities, equipment, and sales/support activities.

Further Information

For further information about the company's business segments, please contact Dataquest's Semiconductors *Worldwide* industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	4,974	5,816	6,447	6,522	6,567
Percent Change	1.02	16.93	10.85	1.16	0.69
Capital Expenditure	447	459	656	863	909
Percent of Revenue	8.99	7.89	10.18	13.23	13.84
R&D Expenditure	406	428	494	506	540
Percent of Revenue	8.16	7.36	7.66	7.76	8.22
Number of Employees	77,270	77,984	75,685	73,854	70,318
Revenue ($K)/Employee	64.37	74.58	85.18	88.31	93.39
Net Income	63	321	366	292	(39)
Percent Change	-	409.52	14.02	(20.22)	(113.36)

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	1,536	1,592	1,680	1,759
Quarterly Profit	13	11	(7)	(56)

Source: Texas Instruments Incorporated
Annual Reports and Forms 10-K
Dataquest (October 1991)

Table 2
Revenue by Geographic Region (Percent)

	1986	1987	1988	1989	1990
North America	70.12	69.64	68.39	68.61	66.79
Europe	14.94	14.86	15.37	14.86	16.19
East Asia	10.78	12.19	14.72	14.90	15.64
All Others	4.16	3.31	1.52	1.63	1.38

Source: Texas Instruments Incorporated
Annual Reports and Forms 10-K
Dataquest (October 1991)

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1990 SALES OFFICE LOCATIONS

North America—46
Europe—14
Japan—9
ROW—12

MANUFACTURING LOCATIONS

North America

Attleboro, Massachusetts
Components, metallurgical materials
Austin, Texas
Defense electronics, digital products
Colorado Springs, Colorado
Defense electronics
Dallas, Texas
Components, defense electronics, digital products
Denton, Texas
Defense electronics
Houston, Texas
Components, digital products
Hunt Valley, Maryland
Digital products
Johnson City, Tennessee
Digital products
Lewisville, Texas
Defense electronics
Lubbock, Texas
Components, digital products
McKinney, Texas
Defense electronics
Midland, Texas
Components
Plano, Texas
Defense electronics, digital products
Sherman, Texas
Components, defense electronics
Temple, Texas
Digital products

Europe

Almelo, Netherlands
Components, digital products
Avezzano, Italy
Components
Bedford, United Kingdom
Components
Freising, Germany
Components
Nice, France
Components
Rieti, Italy
Components, digital products

Japan

Hatogaya, Japan
Components
Hiji, Japan
Components
Miho, Japan
Components
Oyama, Japan
Components

ROW

Baguio, Philippines
Components
Kuala Lumpur, Malaysia
Components
Singapore
Components
Taipei, Taiwan
Components

SUBSIDIARIES

North America

Texas Instruments Asia Limited (United States)
Texas Instruments Canada Limited (Canada)

Europe

Texas Instruments Belgium S.A./N.V. (Belgium)
Texas Instruments Denmark A/S (Denmark)
Texas Instruments Deutschland GmbH (Germany)
Texas Instruments Equipamento Electronico Lda. (Portugal)
Texas Instruments España, S.A. (Spain)
Texas Instruments France S.A. (France)
Texas Instruments Holland B.V. (Netherlands)
Texas Instruments International Trade Corporation (Sweden)

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Texas Instruments (Ireland) Limited (Ireland)
Texas Instruments Italia S.p.A. (Italy)
Texas Instruments Limited (United Kingdom)
Texas Instruments Norge A/S (Norway)
Texas Instruments OY (Finland)
Texas Instruments Switzerland AG (Switzerland)

Japan

Texas Instruments Japan Limited

ROW

Texas Instrumentos Electronicos do Brasil LTDA (Brazil)
Texas Instruments Australia Limited (Australia)
Texas Instruments China Incorporated (China)
Texas Instruments de Mexico, S.A. de C.V. (Mexico)
Texas Instruments Hong Kong Limited (Hong Kong)
Texas Instruments Korea Limited (Korea)
Texas Instruments Malaysia Sdn. Bhd. (Malaysia)
Texas Instruments (Philippines) Incorporated (Philippines)
Texas Instruments Private Limited (India)
Texas Instruments Singapore Pte. Limited (Singapore)
Texas Instruments Taiwan Limited (Taiwan)
Texas Instruments Trade and Investment Company, S.A. (Panama)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

TranSwitch Corporation

Under terms of a licensing agreement, TI will manufacture and market TranSwitch's line of very large scale integrated (VLSI) circuits designed for operating in the DS3 and SONET telecommunications environments.

Canon Incorporated, Hewlett-Packard Company (HP), and the Singapore Economic Development Board

The four companies will jointly construct and own a $330 million dollar wafer fab plant, to be located in Singapore and called TECH Semiconductor Singapore Pte. Ltd. The new plant will use submicron CMOS manufacturing technology to produce DRAMs and possibly logic chips. TI and the Singapore Economic Development Board will each own 26 percent of the new venture, while Canon and HP will own 24 percent each.

Anthem Electronics

TI signed a semiconductor distribution agreement with Anthem as part of its long-term strategy to increase its market penetration. Along with Anthem, TI's distributors now include Alliance Electronics, Arrow, Hall-Mark, Lex Electronics, Marshall and Wyle, and Zeus Components.

Matsushita Electric Industrial Co. Ltd. and NEC Corporation

Texas Instruments reached basic patent cross-licensing agreements with Matsushita and NEC. The agreements, which involve the Kilby patent that covers basic semiconductor technology, are similar to previous pacts with both companies that expired at the end of 1990. As of July 1991, the final agreements had not yet been signed.

Mentor Graphics Corporation

The two companies reached a multiyear agreement that will incorporate design-for-manufacture (DFM) software developed by TI's Information Technology Group into Mentor's Falcon Framework, resulting in the first software to integrate device and board-level DFM concerns at system level. Mentor will handle all marketing, sales, and support for the new technology.

1990

Oki Electric Industry Co. Ltd. and Samsung Electronics Co. Ltd.

TI reached new five-year agreements with Oki and Samsung involving the cross-licensing of semiconductor patents that incorporate TI technology. The agreements replace separate five-year pacts that expired in 1990. The Oki and Samsung agreements are subject to the approval of the governments of Japan and Korea, respectively.

Toshiba Corporation

TI announced a 10-year patent licensing agreement with Toshiba, whereby TI will receive royalties on the sale of Toshiba semiconductors. The pact replaces a five-year agreement, which expired in 1990, resulting from a 1986 patent infringement lawsuit filed by TI against eight Japanese companies and one Korean firm.

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Force Computers
The two companies signed an agreement to jointly design a 64-bit, packet-mode Futurebus protocol controller that incorporates cache coherency mechanisms.

Kobe Steel Ltd.
TI and Kobe Steel established a joint-venture company, KTI Semiconductor Ltd., to manufacture advanced semiconductors in Japan. The company will manufacture primarily CMOS logic devices, including VLSI circuits and ASICs.

Sony Corporation
TI will produce most of the linear and other types of ICs that Sony uses in its electronic home appliances marketed in Europe. The chips—manufactured by TI at its Freising, Germany, plant—will be marketed under Sony's brand name.

Philips Components-Signetics
Philips Components-Signetics and TI signed a multiyear BiCMOS alternate-sourcing and development agreement that will initially revolve around bus interface logic. TI and Signetics are not transferring process technology, but are instead agreeing on the performance specifications of each device as it is designed.

AST Research
AST Research and the Information Technology Group of TI will provide service to users of AST computer systems. This alliance follows an OEM agreement signed by the two companies under which AST is developing custom computer systems for TI.

Toshiba Corporation
Toshiba has obtained a TI licensing agreement that will allow Toshiba to sell laser diode semiconductors made with a TI-patented process in the United States.

FSI International
TI licensed its 150mm photoresist processing system to FSI International. FSI will build and distribute the equipment under the agreement.

Delco Electronics
Delco and TI entered into an agreement to jointly define and develop a new generation of microcontrollers for automotive applications.

1989

Silicon Compiler Systems (SCS)
The two companies agreed to jointly develop advanced IC CAD software technology for the physical verification of integrated circuits. The result of this agreement will be IC-design products to be marketed and supported worldwide exclusively by SCS.

Toppan Printing Company
TI and Toppan (Tokyo) signed an agreement that will bring Toppan Printronics USA into being as a joint venture in order to acquire TI's internal phtomask operation. Toppan will own 85 percent of the new company, and TI will have a 15 percent interest. The new company will be a major supplier of photomasks to TI and will also supply the product to other North American and European semiconductor manufacturers.

Nippon Hoso Kyokai (NHK)
TI signed an agreement with NHK for its MUSE, or "Hi-vision," advanced television receiver technology. TI will use this acquired system knowledge to develop chip sets to participate in three high-definition television (HDTV) markets.

Micron Technology Inc.
The two companies entered into a cross-licensing agreement encompassing the semiconductor patents of both companies.

Acer Incorporated
The two companies agreed to create a privately held joint venture company in Taiwan to manufacture 1Mb and 4Mb DRAMs.

Hitachi Ltd.
Hitachi and TI entered into an agreement to jointly develop a common 16Mb DRAM technology and allow access to each other's DRAM technology as it relates to the development of the 16Mb DRAM device.

1988

Actel
Actel and TI announced a seven-year agreement covering Actel's desktop-configurable, channeled gate arrays and proprietary PLICE antifuse technology.

Cypress Semiconductor Corporation
The two companies will codevelop and second source SPARC-related microprocessors, floating-point processors, and other peripherals.

Sun Microsystems Inc.
Sun Microsystems and TI signed a comprehensive, long-term licensing and cooperative development agreement in which Sun will license to TI a broad range of its products and technology, including SPARC chips. TI and Sun will also codevelop the next generation of SPARC microprocessors.

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Altera Corporation
The two companies signed a long-term agreement that encompasses a seven-year technology exchange and supply arrangement for high-performance, high-density, erasable programmable logic devices.

Raytheon Company
Raytheon and TI are one of four teams selected by the U.S. Department of Defense to develop and produce GaAs circuits.

VoxTron
TI will incorporate its hardware and voice verification technology with VoxTron's Veriton Series 1000, a voice-activated access-control system.

MERGERS AND ACQUISITIONS

1991

James Martin Associates
TI purchased the European CASE operations of JMA in a deal worth approximately $30 million. JMA is best known for its involvement with TI in the marketing of TI's IEF CASE package in the United Kingdom.

1989

Microsemi
Microsemi acquired the complete military discrete power and small-signal product lines of TI, including radiation-hardened technologies.

KEY OFFICERS

Jerry R. Junkins
Chairman of the board, president, and chief executive officer

William I. George
Executive vice president

William B. Mitchell
Executive vice president

William P. Weber
Executive vice president

Richard J. Agnich
Senior vice president, secretary, and general counsel

William A. Aylesworth
Senior vice president, treasurer, and chief financial officer

PRINCIPAL INVESTORS

Northern Trust Corporation—11.2 percent

FOUNDERS

Cecil Green
Patrick Haggerty
Erik Jonsson
Eugene McDermott

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Table 3
Balance Sheet
Fiscal Year Ending in December
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash	207	422	541	418	403
Receivables	670	848	942	943	944
Short-Term Investments	7	241	239	219	9
Inventory	610	739	770	806	887
Other Current Assets	288	53	57	60	62
Total Current Assets	1,782	2,303	2,549	2,446	2,305
Net Property, Plants	1,437	1,520	1,726	2,130	2,480
Other Assets	118	135	153	228	263
Total Assets	3,337	3,958	4,428	4,804	5,048
Total Current Liabilities	1,113	1,236	1,199	1,303	1,479
Long-Term Debt	192	487	624	617	715
Other Liabilities	305	349	361	399	496
Total Liabilities	1,610	2,072	2,184	2,319	2,690
Converted Preferred Stock	300	300	300	300	300
Common Stock	26	79	81	82	82
Other Equity	362	355	433	478	486
Retained Earnings	1,039	931	1,209	1,404	1,269
Converted Money Market	0	221	221	221	221
Total Shareholders' Equity	1,727	1,886	2,244	2,485	2,358
Total Liabilities and Shareholders' Equity	3,337	3,958	4,428	4,804	5,048

Source: Texas Instruments Incorporated Annual Reports and Forms 10-K
Dataquest (October 1991)

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Table 5
Consolidated Income Statement
Fiscal Year Ending in December
(Millions of U.S. Dollars, except Per Share Data)

Income Statement	1986	1987	1988	1989	1990
Revenue	4,974	5,816	6,447	6,522	6,567
U.S. Revenue	3,488	4,050	4,409	4,475	4,386
Non-U.S. Revenue	1,486	1,766	2,038	2,047	2,181
Cost of Sales	4,035	4,410	4,836	5,090	5,327
R&D Expense	406	428	494	506	540
SG&A Expense	827	909	1,017	1,045	1,183
Capital Expense	446	459	656	863	909
Pretax Income	87	402	516	355	(21)
Pretax Margin (%)	1.75	6.91	8.00	5.44	(0.32)
Effective Tax Rate (%)	NA	NA	NA	NA	NA
Net Income	63	321	366	292	(39)
Shares Outstanding, Thousands	75,942	82,023	84,820	84,934	81,614
Per Share Data					
Earnings	0.69	3.74	4.05	3.04	(0.92)
Dividend	0.67	0.71	0.72	0.72	0.72
Book Value	22.74	22.99	26.46	30.30	31.05

NA = Not available

Source: Texas Instruments Incorporated Annual Reports and Forms 10-K
Dataquest (October 1991)

Table 6
Key Financial Ratios
Fiscal Year Ending in December

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	1.60	1.86	2.13	1.88	1.56
Total Assets/Equity (%)	193.23	209.86	197.33	193.32	214.08
Current Liabilities/Equity (%)	64.45	65.54	53.43	52.43	62.72
Total Liabilities/Equity (%)	93.23	109.86	97.33	93.32	114.08
Profitability (%)					
Return on Assets	1.89	8.11	8.27	6.08	(0.77)
Return on Equity	3.65	17.02	16.31	11.75	(1.65)
Profit Margin	1.27	5.52	5.68	4.48	(0.59)
Other Key Ratios					
R&D Spending % of Revenue	8.16	7.36	7.66	7.76	8.22
Capital Spending % of Revenue	8.97	7.89	10.18	13.23	13.84
Employees	77,270	77,984	75,685	73,854	70,318
Revenue ($K)/Employee	64.37	74.58	85.18	88.31	93.39
Capital Spending % of Assets	13.37	11.60	14.81	17.96	18.01

Source: Texas Instruments Incorporated Annual Reports and Forms 10-K
Dataquest (October 1991)

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Minato-ku, Tokyo 105, Japan
Telephone: (03) 457-4511
Fax: (03) 456-1631
Dun's Number: 06-499-3082

Date Founded: 1875

CORPORATE STRATEGIC DIRECTION

Toshiba Corporation is one of the largest electronics companies worldwide. Its main business activity is the development, manufacturing, and marketing of electrical and electronics equipment and electronic components. The business is divided into the following segments: Information/Communication Systems and Electronic Devices, which accounts for 50 percent of net sales; Heavy Electrical Apparatus, which accounts for 19 percent of net sales; and Consumer Products, which accounts for 31 percent of net sales.

Toshiba is one of two leaders of the Toshiba-IHI Group; the other is Ishikawajima-Harima Heavy Industries (IHI). These parents have close capital and business connections. Their subsidiaries are engaged in electrical and electronics products, construction, trading and finance, and shipbuilding.

Total revenue for 1991 amounted to $33.3 billion,* an increase of 12 percent over 1990 revenue of $29.7 billion. Domestic sales decreased slightly from 60.73 percent in 1990 to 54.99 percent in 1991. International sales also dropped slightly from 31.62 percent to 30.98 percent. Fierce competition in the key semiconductor and computer markets led to a decrease in net income of 7.15 percent during 1991. Net income totaled $856.2 million, compared with $922.1 in 1990.

Toshiba has developed a "Sixth Medium-Term Plan." This plan will cover the period from 1991 through 1993. The focus of this plan is group, growth, and global. Group represents Toshiba's goal to strengthen its group of companies. This will be done by building on the synergies that exist among its lines of business and by making strategic alliances. For growth, Toshiba plans to increase total sales about 60 percent by 1993. This will be done by offering value-added products that unify the collective expertise of Toshiba's numerous divisions and group companies. In addition, the contribution of overseas sales is scheduled to rise from 35 to 39 percent of total sales. In order to meet this goal, Toshiba will need to build on its commitment to developing markets worldwide. Global represents how Toshiba will build on its global presence. Toshiba plans to raise overseas sales as a percentage of total sales by increasing overseas production and strengthening marketing operations in local markets.

R&D is structured by Toshiba to incorporate both long- and short-term planning by developing projects of varying time frames. Corporate level undertakes projects with a five- to ten-year time frame, division level operates under three-year time frames, division engineering level goes by one-year time frames, and division manufacturing strives for continuous day-to-day improvement. Therefore, Toshiba can take both long- and short-term perspectives.

R&D expenditure increased 13 percent from $1.86 billion in 1990 to $2.1 billion in 1991 and represented 6.37 percent of sales in 1991. This expenditure was concentrated primarily on 16Mb and 64Mb DRAMs, large color liquid crystal displays (LCDs), new high temperature superconducting materials for future electronic devices, and various equipment for train systems. A large share of activities was also focused on information and communications systems, such as broadband ISDN (BISDN) switching equipment. Toshiba plans to raise R&D expenditure 7 percent during the 1992 fiscal year.

Capital expenditure for the same period totaled $3.1 billion, a 35 percent increase over 1990,

*All dollar amounts are in U.S. dollars.

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which totaled $2.3 billion. The rise in capital spending during fiscal 1990 and 1991 was primarily the result of development and production of 4Mb and 16Mb DRAMs. Over $1.4 billion was invested in the semiconductor group during the fiscal year; and several new factories are either currently under construction or already completed. During fiscal 1992, capital expenditure is expected to be approximately $3.5 billion.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 through 7 at the end of this backgrounder present comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Information/Communication Systems and Electronic Devices

Fiscal 1991 sales in this segment were $16.7 billion and accounted for 50 percent of company sales.

A companywide program developed by Toshiba to strengthen its capabilities in information and communications systems contributed to the sale of notebook and laptop computers, which were up 40 percent during 1991. Although semiconductor memory sales were flat, sales of ASICs grew 6 percent in that product segment. Toshiba also introduced a second generation 4Mb DRAM that features a smaller chip size and faster access time.

Semiconductors

According to Dataquest, Toshiba remained the second-largest semiconductor supplier in 1990, with 8.3 percent of the worldwide market share and revenue of $4.8 billion. Toshiba also was the third-largest semiconductor supplier in Japan. Toshiba's diversified product portfolio emphasizes balance among analog, discrete, bipolar, MOS logic, memory devices, and ASICs.

Toshiba was also the largest worldwide supplier of discrete devices in 1988, 1989, and 1990. In 1990, Toshiba captured an 11.0 percent market share totaling $904 million in revenue. Toshiba has stated its goal to remain No. 1 in discretes. Toshiba ranked second, with a 9.2 percent market share and $838 million in revenue, in the MOS logic semiconductor segment and third in the MOS digital semiconductor segment with $2.9 billion in revenue. In the analog semiconductor industry Toshiba ranked third, capturing a 5.8 percent market share, according to Dataquest.

In the DRAM market, Toshiba is committed to increasing 4Mb DRAM production and has responded to demand by developing and producing a wide range of products. In October 1991, Toshiba announced a new series of 4Mb DRAMs with a 512K×9 structure. The device has the standard data capacity of 512K×8, plus an additional 512K×1 capacity for a parity bit. Dataquest believes that this is one of what will be many announcements for this type of product.

According to Dataquest, in 1990 Toshiba remained the largest supplier of 1Mb DRAMs to worldwide markets for the second consecutive year. It was second in the 4Mb product area, having held the top spot during 1989. However, during 1990 Toshiba adjusted to a 4Mb DRAM market shift, from a 350-mil-wide device, the 4Mb part with which it started, to the now industry-standard 300-mil part. During 1991 and 1992, the company will emphasize the 4Mb DRAM density and de-emphasize the 256K DRAMs and 1Mb DRAMs. Toshiba should remain a leader in the DRAM market for the foreseeable future and a major player in the 4Mb video RAM (VRAM) segment as that market emerges. Toshiba ranked first in the MOS memory semiconductor arena with $1.6 billion in revenue and a 12.4 percent market share.

Dataquest ranked Toshiba third in the worldwide optoelectronic semiconductor industry, with an 11.6 percent share of the 1990 market.

During fiscal 1991, Toshiba invested approximately $226 million in its LCD business. Preparations for expansion into this market included the construction of LCD manufacturing facilities for the joint venture with IBM Japan, Display Technologies Inc.

Personal Computers

Toshiba is developing sophisticated, high-performance PC systems to position the company at the forefront of current and emerging high-growth fields. In 1990, according to Dataquest, Toshiba ranked tenth worldwide and captured 3.6 percent of

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the worldwide PC market. Dataquest believes that Toshiba is now the dominant player in the world market for laptops, with a 1990 market share of 29.4 percent in the worldwide laptop/DC market and a 21.6 percent market share in the worldwide laptop/AC market.

Workstations

Toshiba markets a line of UNIX engineering workstations incorporating original hardware and Japanese-version software. This line has done well in the Japanese market.

Telecommunications Equipment

Under a development contract with NTT, Toshiba is developing an asynchronous transfer mode (ATM) switching system for BISDN, the next-generation telecommunications network. Also, in a joint effort with Kokusai Denshin Denwa (KDD), Japan's international telephone service corporation, Toshiba has developed the first satellite communications system in Japan for installation in commercial airliners to enable air-to-ground telephone communication. Demand from the growing mobile portable and cordless telephone markets is being met, and an ultralight, ultracompact portable telephone that conforms to U.S. standards has been developed. According to Dataquest, in 1990 Toshiba ranked ninth in the United States in total PBX systems with a 2.5 percent market share.

Toshiba is a major supplier of facsimile products worldwide. Much of its success stems from the effective diversification of the product line to best suit the trends in market demand. Toshiba meets the high-end demand with products that will transmit a standard document in just 13 seconds. The products feature one-touch dialing and automatic Optical Mark Recognition (OMR) dialing. Toshiba also has models that offer an additional electronic memory, which adds such valuable functions as broadcasting, mailbox, and relay transmission. In addition, Toshiba offers compact, entry-level machines with one-touch dialing. In 1990, according to Dataquest, Toshiba ranked sixth worldwide with a 5.6 percent market share.

Toshiba is one of the top 10 suppliers of key telephone systems to the U.S. market. These systems are customer-premises telephone switching systems that allow telephones to interface to the public network without dialing access codes. Competition is stiff in this market segment because the top 10 suppliers account for 85 percent of the market, and there is very little differentiation among their technologies. For 1990, according to Dataquest, Toshiba ranked fifth in the key telephone systems area in the United States with a 5.7 percent market share.

Printers

Toshiba manufactures dot matrix, laser, and thermal transfer printers, with the overwhelming majority of business in the first two product areas. According to Dataquest, for 1990 Toshiba had less than a one percent share of the North America printer market.

Copiers

Toshiba sells and manufactures plain paper copiers (PPCs) on a global scale. According to Dataquest, Toshiba is one of the top 10 PPC manufacturers in the United States, placing 51.9 thousand PPCs during 1990.

Computer Storage

Toshiba is one of the leading optical drive suppliers. According to Dataquest, for 1990 Toshiba ranked fourth in the 12-inch worldwide write-once/read-many (WORM) market with a 10.0 percent market share. In the CD-ROM market it also ranked fourth with a 9.2 percent market share. Toshiba ranked fifth in the total optical disk drive market with a market share of 3.5 percent worldwide.

Heavy Electrical Apparatus

In fiscal 1991, Toshiba's Heavy Electrical Apparatus segment accounted for 19 percent of its net sales, totaling $6.4 billion compared with $618.6 million in 1990, reflecting a 14 percent increase over 1990. Domestic sales grew due to completion of large-scale nuclear power plants and high demand for electrical equipment stimulated by brisk capital investment. However, exports were down because of decreased plant deliveries.

Toshiba will continue to emphasize the development of its energy business, focusing on three systems. In the nuclear power generation sector, Toshiba is continuing to develop advanced, simplified systems that incorporate improvements in safety, reliability, and operability. The second system is thermal power

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plants. Toshiba is developing and refining a system that includes a combined cycle that will achieve new levels of turbine efficiency. The third system is fuel cells. According to Toshiba, the fuel cells show great promise as a superior next-generation source of clean energy.

Consumer Products

Fiscal 1991 sales of products in this segment rose 9 percent to $10.2 billion, accounting for 31 percent of Toshiba's net sales. The high added value of products in the domestic market and smooth expansion of overseas manufacturing operations both contributed to the gain. Domestic demand centered on air conditioners, large-screen TVs incorporating broadcast satellite tuners, lighting products, and materials.

The consumer products business has been restructured to reflect the continuing development of the information society and the personal and household use of information and communications devices. The Consumer Products Group has been separated into two business units, the Video & Electronics Media Group and the Airconditioners & Appliances Group. The Video & Electronics Media Group aims to position Toshiba as a major presence in multimedia.

Further Information

For further information about the company's business segments, please contact the appropriate Dataquest industry service.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1987	1988	1989	1990	1991
Five-Year Revenue	20,734.7	25,881.3	29,636.6	29,748.8	33,251.2
Percent Change	36.01	24.82	14.51	0.38	11.77
Capital Expenditure	1,337.1	1,359.7	2,086.5	2,263.3	3,122.3
Percent of Revenue	6.45	5.25	7.04	7.61	9.39
R&D Expenditure	1,260.7	1,575.0	1,796.5	1,860.4	2,117.4
Percent of Revenue	6.08	6.09	6.06	6.25	6.37
Number of Employees	121,000	122,000	125,000	142,000	162,000
Revenue ($K)/Employee	171.36	212.14	237.09	209.50	205.25
Net Income	214.4	439.8	9,310.0	922.1	856.2
Percent Change	(20.15)	105.13	2,016.87	(90.10)	(7.15)
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

1991 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA= Not available

Source: Toshiba Corporation
Annual Reports
Dataquest (January 1992)

Table 2
Revenue by Geographic Region (Percent)

Region	1987	1988	1989	1990	1991
Japan	69.14	69.03	67.93	60.73	54.99
Overseas	30.86	30.97	32.07	31.62	30.98

Source: Toshiba Corporation
Annual Reports
Dataquest (January 1992)

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1991 SALES OFFICE LOCATIONS

Europe—4
Asia/Pacific—77
Japan—67
ROW—11

MANUFACTURING LOCATIONS

North America

International Fuel Cells
A joint venture with United Technologies to produce fuel cells
Microelectronics Center
Semiconductors
Toshiba America Inc.
TVs, microwave ovens, VCRs, toners, telephones, medical equipment
Toshiba International
Motors, circuit boards, control equipment
Toshiba Westinghouse Electronics
A joint venture to produce color CRTs

Europe

Compagnie Europeen Pour La Fabrication D'Enceintes A Micro-Ondes (France)
A joint venture with Thomson of France to produce microwave ovens
Toshiba Consumer Products GmbH (Germany)
VCRs, TVs
Toshiba Consumer Products Ltd. (United Kingdom)
TVs, VCRs, microwave ovens
Toshiba Consumer Products S.A. (France)
Lamps for copiers
Toshiba Semiconductor GmbH (Germany)
Semiconductors
Toshiba Systemes S.A. (France)
A joint venture with ROHM Poulanc to produce plain paper copiers

Asia/Pacific

Amori Taic (Japan)
Radio cassette recorders, record players, component stereos
Buzen Toshiba Electronics Co. Ltd. (Japan)
Semiconductors
Hankook Tungsten (South Korea)
Tungsten, molybdenum wires and parts
Harison Denki (Japan)
Electric lamps
Himeji Toshiba Electronics (Japan)
ICs, lead frames for semiconductors
Hokuto Electronics (Japan)
CRTs
Iwate Toshiba Electronics Co. Ltd. (Japan)
Semiconductors
Kaga Toshiba Electronics (Japan)
Semiconductors
Kitashiba Electric Co. Ltd. (Japan)
Transformers, electric motors
Kitsuki Toshiba Electronics (Japan)
Semiconductors
Korea Electronics (South Korea)
Semiconductors, TVs
Kumdong Lighting (South Korea)
Fluorescent lamps
Leechun Electric Mfg. (South Korea)
Generators, motors, transformers, pumps
Marcon Electronics Co. Ltd. (Japan)
Capacitors, hybrid ICs
Nishishiba Electric Co. Ltd. (Japan)
Electric marine equipment
Nougata Toshiba Electronics (Japan)
Semiconductors
Olivetti Corporation of Japan (Japan)
Data communications equipment, computers, word processing systems, typewriters
Onkyo Corporation (Japan)
Audio equipment and parts
Shibaura Engineering Works Co. Ltd. (Japan)
Motors, electric tools
Sord Computer (Japan)
Microcomputer and peripherals
Tatung Co. (Taiwan)
TVs, refrigerators, transformers
Thai Toshiba Electric Industries Co. Ltd. (Thailand)
A joint venture with Siam Cement of Thailand to produce TVs, refrigerators, electric fans, electric rice cookers, motors
Thai Toshiba Fluorescent Lamp Co. Ltd. (Thailand)
Glass tubes for fluorescent lamps
Thai Toshiba Lighting Co. Ltd. (Thailand)
Fluorescent lamps
Tohoku Semiconductor (Japan)
Semiconductors
Toki Electric Industrial (Japan)
Electric lamps, lighting equipment

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Tokyo Electric Co. Ltd. (Japan)
Business machines, lighting equipment, home appliances
Tokyo Electronic Industry Co. Ltd. (Japan)
Industrial video equipment, control equipment
Tokyo Optical (Japan)
Optical instruments
Toshiba Battery (Japan)
Dry batteries, battery applied products
Toshiba Ceramics (Japan)
Ceramics
Toshiba Chemical Corporation (Japan)
Plastic products, insulating materials
Toshiba Cold Chain (Japan)
Freezers, vending machines
Toshiba Components Co. Ltd. (Japan)
Semiconductors
Toshiba Electric Equipment Co. Ltd. (Japan)
Lighting fixtures
Toshiba Electronics Malaysia Sdn. Bhd. (Malaysia)
IC memories
Toshiba Electronic Systems Co. Ltd. (Japan)
A joint venture with General Electric to produce and market electronic equipment
Toshiba Engineering & Construction Co. Ltd. (Japan)
Electric facilities
Toshiba Glass Co. Ltd. (Japan)
Glass products
Toshiba Heating Appliances (Japan)
Oil heating equipment
Toshiba Kiki (Japan)
Lighting equipment, etc.
Toshiba Machine (Japan)
Machinery, machine tools
Toshiba Medical Systems Co. Ltd. (Japan)
Medical electronic equipment
Toshiba Seiki (Japan)
Automatic precision apparatus
Toshiba Singapore Pte. Ltd. (Singapore)
Color TVs, TV parts, audio equipment
Toshiba Steel Tube Co. Ltd. (Japan)
Steel tubes, electric conduit tubes
Toshiba Tungaloy (Japan)
Special alloy tools

ROW

Industria Mexicana Toshiba S.A. (Mexico)
Semiconductors
Semp Toshiba Amazonas S.A. (Brazil)
TVs, audio equipment
Toshiba Electromex S.A. de C.V. (Mexico)
Color TV parts for Toshiba America

SUBSIDIARIES

North America

GE Toshiba Lighting Corporation (United States)
Ottawa Design Center (Canada)
Toshiba America Consumer Products Inc. (United States)
Toshiba America Electronic Components Inc. (United States)
Toshiba America, Inc. (United States)
Toshiba America Information Systems Inc. (United States)
Toshiba America Medical Systems Inc. (United States)
Toshiba Display Devices Inc. (United States)
Toshiba Hawaii Inc. (United States)
Toshiba International Corporation (United States)
Toshiba of Canada Ltd. (Canada)

Europe

Compagnie European Pour La Fabrication D'Enceintes A Micro-Ondes (France)
Toshiba AG (Switzerland)
Toshiba Consumer Products GmbH (Germany)
Toshiba Consumer Products Ltd. (United Kingdom)
Toshiba Consumer Products S.A. (France)
Toshiba Deutschland GmbH (Germany)
Toshiba Electronics Espana S.A. (Spain)
Toshiba Electronics Europe GmbH (Germany)
Toshiba Electronics Italiana S.R.L. (Italy)
Toshiba Electronics Ltd. (United Kingdom)
Toshiba Electronics Scandinavia AB (Sweden)
Toshiba Europa GmbH (Germany)
Toshiba Information Systems (Belgium)
Toshiba Information Systems Ltd. (United Kingdom)
Toshiba Information Systems S.A. (Spain)
Toshiba Information Systems S.p.A. (Italy)
Toshiba Informationssyteme GmbH (Germany)
Toshiba International (Europe) Ltd. (United Kingdom)
Toshiba International Finance B.V. (Netherlands)
Toshiba International Finance Ltd. (United Kingdom)
Toshiba Ltd. (United Kingdom)
Toshiba Medical Systems Europe B.V. (Netherlands)
Toshiba Semiconductor GmbH (Germany)
Toshiba Systemes S.A. (France)

Asia/Pacific

Iwate Toshiba Electronics Co. Ltd. (Japan)
Kitashiba Electric Co. Ltd. (Japan)

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Kyodo Building Corporation (Japan)
Man On Toshiba Ltd. (Hong Kong)
Marcon Electronics Co. Ltd. (Japan)
Minato Building Co. Ltd. (Japan)
Nikko Jitsdugyo Co. Ltd. (Japan)
Nishishiba Electric Co. Ltd. (Japan)
Onkyo Corporation (Japan)
Shibaura Engineering Works Co. Ltd. (Japan)
TDH, Inc. (Japan)
Thai Toshiba Electric Industries Co. Ltd. (Thailand)
Tokyo Electric Co. Ltd. (Japan)
Toshiba Automation Co. Ltd. (Japan)
Toshiba Battery Co. Ltd. (Japan)
Toshiba Builders Appliance Co. Ltd. (Japan)
Toshiba Building Corporation (Japan)
Toshiba Ceramics Co. Ltd. (Japan)
Toshiba Chemical Corporation (Japan)
Toshiba Components Co. Ltd. (Japan)
Toshiba Consumer Products Co. Ltd. (Thailand)
Toshiba Credit Corporation (Japan)
Toshiba Display Devices Co. Ltd. (Thailand)
Toshiba Electric Appliances Co. Ltd. (Japan)
Toshiba Electric Equipment Corp. (Japan)
Toshiba Electronic Systems Co. Ltd. (Japan)
Toshiba Electronics Asia, Ltd. (Hong Kong)
Toshiba Electronics Malaysia Sdn. Bhd. (Malaysia)
Toshiba Electronics Taiwan Corporation (Taiwan)
Toshiba Elevator & Escalator Service Co. Ltd. (Japan)
Toshiba Engineering & Construction Co. Ltd. (Japan)
Toshiba Engineering Co. Ltd. (Japan)
Toshiba Glass Co. Ltd. (Japan)
Toshiba Heating Appliances Co. Ltd. (Japan)
Toshiba Higashinihon Consumer Electronics Co. Ltd. (Japan)
Toshiba Information Equipment Co. Ltd. (Japan)
Toshiba International Corporation Pty. Ltd. (Australia)
Toshiba Lightec Corporation (Japan)
Toshiba Medical Systems Co. Ltd. (Japan)
Toshiba Physical Distribution Co. Ltd. (Japan)
Toshiba Pty. Ltd. (Australia)
Toshiba Sales and Services Sdn. Bhd. (Malaysia)
Toshiba Silicone Co. Ltd. (Japan)
Toshiba Singapore Pte. Ltd. (Singapore)
Toshiba Steel Tube Co. Ltd. (Japan)
Toshiba Thailand Co. Ltd. (Thailand)

ROW

Industria Mexicana Toshiba S.A. (Mexico)
Semp Toshiba Amazonas S.A. (Brazil)
T and S Servicos Industrias S/C Ltda. (Brazil)
Toshiba de Brasil S.A. (Brazil)
Toshiba de Panama S.A. (Panama)
Toshiba Electromex S.A. de C.V. (Mexico)
Toshiba Medical de Brasil Ltda. (Brazil)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Motorola Inc.

Motorola Inc.'s semiconductor products sector signed a joint-development agreement with Toshiba to design a MUSE (Multiple Sub-nyquist Encoding) decoder chip set for HDTV systems used in Japan. The chips are expected to be completed by the middle of 1992.

Sun Microsystems Inc.

Sun Microsystems Inc. and Toshiba will jointly develop the technology required to commercialize multimedia workstations, which will be compatible with the BISDN telecommunications service.

Synergy Semiconductor

Toshiba has acquired approximately a 10 percent minority stake in Synergy Semiconductor. This strategic alliance will provide for a joint-development effort to build libraries of high-speed ECL and E-BiCMOS ASIC designs. Under the agreement, Toshiba will build 6-inch submicron production lines in Japan for the to-be-designed ECL and E-BiCMOS ASICs.

Echelon Corporation

Echelon has licensed to Toshiba and Motorola the Neuron chip family, its local operating network (LON) product lines. The chip family comprises of two members: the 3210 and 3150.

TEC Electronics

Toshiba has licensed TEC Electronics, a subsidiary of its Tokyo Electric Corp. affiliate, to market its Dynabook notebook personal computers, along with the point-of-sale terminals that Toshiba manufactures.

Bull Micral of America

Toshiba entered into the PC logic chip set business with a chip set for 486-based Micro Channel systems licensed from Bull Micral of America, an affiliate of Groupe Bull.

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Texas Instruments Inc.
Texas Instruments Inc. and Toshiba signed a 10-year patent cross-licensing agreement. Toshiba will pay Texas Instruments royalties for using the patented chip technology.

1990

IBM Japan Ltd.
Toshiba and IBM Japan are jointly constructing a plant that will have a production capability of 50,000 LCD panels a year.

Motorola Inc.
Toshiba and Motorola reportedly plan to sign an agreement to exchange gate array technology to allow the companies to act as mutual second sources. In the United States, Motorola will produce gate arrays designed and developed by Toshiba, which Motorola intends to market for use in workstations. In Japan, Tohoku Semiconductor Inc., a joint venture of the two companies, will produce gate arrays based on Motorola technology for supply to local companies. Toshiba and Motorola also plan to expand their technological cooperation to include discrete semiconductors.

Businessland
Businessland Japan will be formed by Businessland, Canon, Fujitsu, software distributor Softbank, Sony, and Toshiba to provide systems integration services for international firms. Businessland will have a 54 percent stake in the joint venture, Softbank will have 26 percent, and the other firms will have 5 percent each.

Spectrum Cellular Corp.
Toshiba will market Dallas-based Spectrum Cellular's new cellular/landline modem with its laptop computers as the T24D/X, and Spectrum will also develop five separate versions of its new SmartCable product for sale by Toshiba.

General Electric (GE)
GE and Toshiba have entered into a joint marketing agreement covering the sale of GE's CompuScene PT2000 in Japan. The visual simulation system and other Compu-Scene products will be distributed by Toshiba Electronics Systems, a GE/Toshiba joint venture company.

Echelon Systems Corp.
Motorola and Toshiba have become the first semiconductor makers to license the rights to a new generation of intelligent power-controller chips being developed by Echelon Systems. Under the terms of the agreement, Toshiba's Semiconductor Group will manufacture and market the Echelon-designed ICs. The agreement also permits Toshiba to design, manufacture, and market enhanced versions of the chips.

1989

EDA Systems Inc.
EDA signed a purchase agreement with Toshiba for its Powerframe product, a design management framework that integrates third-party CAD/CAE tools and speeds the overall electronic design process.

IBM Corporation
The two companies agreed to the joint development of a color flat panel display for computers that is larger and clearer than any demonstrated previously.

Digital Equipment Corporation
The companies have a technology exchange agreement that will ensure the integration of Toshiba's laptop personal computers into Digital's networking environment.

Weitek Corporation
Under a joint development agreement, Weitek will manufacture some of its semiconductors in Toshiba's plant; Toshiba will gain access to some of Weitek's floating-point product technology.

McDonnell Douglas
McDonnell Douglas has agreed to port its PRO-IV application development language to minicomputers manufactured by Toshiba.

Cummins Engine Co.
The companies have undertaken a joint venture to market silicon nitride ceramic components in North America.

Sun Microsystems Inc.
The companies signed a worldwide licensing agreement to bundle the SPARC MPU architecture, the SunOS operating system, and the Open Look Graphics interface into a series of small-footprint, low-cost computers.

Siemens
The companies extended their long-standing alliance in ASICs.

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1988

Zoran
The companies agreed to a technology and manufacturing alliance.

Motorola Inc.
Under a joint venture, the companies formed Tohoku Semiconductor. Tohoku is using Toshiba's marketing channels to market Motorola's 68000 series MPUs in Japan.

Advanced Silicon Corporation
Toshiba agreed to provide Advanced Silicon Corporation with 6-inch CMOS wafers and jointly develop ASIC software.

Siemens and GE
The companies agreed to jointly develop a common cell library.

SGS-Thomson
The companies extended a six-year agreement to patent cross-licensing related to semiconductor technology.

1987

GRiD
Toshiba agreed to supply GRiD with an IBM PC AT-compatible kneetop computer.

Mitsui Petrochemical
The companies undertook the joint development of a magnetic tape emulator.

Viewlogic Systems
Viewlogic Systems is the principal worldwide supplier of CAE software for Toshiba.

Aida Corporation
Toshiba agreed to provide Aida with its TC17G gate array library models. Toshiba is gaining access to Aida's semicustom IC design equipment.

SGS-ATES
The companies made a five-year technical collaboration agreement allowing Toshiba to use SGS-ATES' semiconductor sales network in Europe and allowing SGS-ATES to receive LSI fab technology and technical training for its engineers from Toshiba.

SDA Systems
The companies undertook a five-year joint venture to cooperatively develop CAD systems for IC design.

MERGERS AND ACQUISITIONS

1991

UNIX System Laboratories
AT&T sold one-fifth of its UNIX System Laboratories to eleven computer companies, including Toshiba. The other computer companies involved are Motorola Inc., Novell Inc., Sun Microsystems Inc., NEC America Inc., England's ICL, Ing. C. Olivetti & Co. of Italy, the Institute for Information Industry of Taiwan, Fujitsu Ltd., and Oki Electric Industries Co. Ltd.

Vertex Semiconductor Corporation
Toshiba America Electronic Components Inc. acquired Vertex Semiconductor Corporation for approximately $20 million. Vertex is a designer and manufacturer of high-performance, multichip ASICs for high gate count, performance-driven electronic systems. Toshiba had already owned a 14 percent equity stake under a three-year agreement signed in 1989.

1990

Toshiba Display Devices Inc. and Toshiba America Electronic Components Inc.
These two Toshiba subsidiaries have been merged to complete the consolidation of all of Toshiba's North American components marketing, sales, and manufacturing operations.

Power and Design
Toshiba has acquired Power and Design, a Belgian distributor for Toshiba. The new subsidiary will be renamed Toshiba Information Systems and will deal with marketing and sales for Toshiba-made printers, photocopiers, personal computers, and fax machines. The subsidiary is the seventh sales outlet for Toshiba communications and information equipment in Europe.

Integrated CMOS Systems Inc. (ICS)
Toshiba has acquired equity stake in ICS. The acquisition will enable Toshiba to use the U.S. firm's design tools with existing customers, and, under its own name, Toshiba will market a new array family that will be developed using submicron CMOS technology. (Note: ICS subsequently changed its name to Vertex Semiconductor Corporation.)

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KEY OFFICERS

Joichi Aoi
President and chief executive officer

Tsuyoshi Kawanishi
Senior executive vice president

Keiichi Komiya
Senior executive vice president

Kinichi Kadono
Senior executive vice president

Fumio Sato
Senior executive vice president

PRINCIPAL INVESTORS

The Dai-ichi Mutual Life Insurance Company—4.3 percent
Nippon Life Insurance Company—3.6 percent
The Mitsubishi Trust & Banking Corporation—3.1 percent
The Mitsui Bank Limited—3.1 percent

FOUNDERS

Information is not publicly available.

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Table 3
Consolidated Balance Sheet
Fiscal Year Ending in March
(Millions of U.S. Dollars)

Balance Sheet	1987	1988	1989	1990	1991
Cash	1,279.5	3,681.8	4,964.5	7,127.3	5,998.9
Receivables	4212.6	5,223.5	6,885.8	7,131.5	8,288.4
Marketable Securities	1,284.5	1,409.8	1,334.1	1,323.7	1,373.8
Inventory	3,363.8	5,308.7	6,434.3	6,716.6	7,808.2
Other Current Assets	1,153.5	1,333.8	1,613.3	1,784.8	1,882.3
Total Current Assets	12,347.7	17,030.4	21,232.0	24,083.8	25,351.6
Net Property, Plants	4,666.5	5,346.6	6,158.3	6,336.0	7,915.2
Other Assets	3,573.2	4,399.8	5,402.7	5,830.8	5,896.9
Total Assets	20,587.4	26,776.8	32,793.0	36,250.6	39,163.7
Total Current Liabilities	11,500.1	15,018.5	19,002.7	19,287.1	20,713.1
Long-Term Debt	4,570.0	5,642.3	6,007.0	8,429.3	9,112.7
Other Liabilities	800.5	915.0	918.6	937.5	991.4
Total Liabilities	16,870.6	21,575.8	25,928.3	28,653.9	30,817.2
Common Stock	951.6	1,424.3	1,791.0	1,831.0	1,924.8
Other Equity	935.3	1,489.5	1,894.0	2,359.2	2,475.7
Retained Earnings	1,829.7	2,287.2	3,180.0	3,406.6	3,945.9
Total Shareholders' Equity	3,716.8	5,201.0	6,864.7	7,596.7	8,346.4
Total Liabilities and Shareholders' Equity	20,587.4	26,776.8	32,793.0	36,250.6	39,163.7
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Toshiba Corporation
Annual Reports
Dataquest (January 1992)

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Table 4
Consolidated Income Statement
Fiscal Year Ending in March
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	20,734.7	25,881.3	29,636.6	29,748.8	33,251.2
Japanese Revenue	14,336.8	17,865.7	20,133.3	18,065.5	18,285.5
Non-Japanese Revenue	6,397.9	8,015.6	9,503.3	9,405.3	10,302.4
Cost of Sales	15,223.8	18,640.2	20,150.0	20,037.8	22,509.0
R&D Expense	1,260.7	1,575.0	1,796.5	1,860.4	2,117.4
SG&A Expense	5,187.4	6,443.5	7,553.2	7,500.9	8,886.1
Capital Expense	1,337.1	1,359.7	2,086.5	2,263.3	3,122.3
Pretax Income	489.0	909.2	1,830.8	1,886.9	1,833.4
Pretax Margin (%)	2.36	3.51	6.18	6.3	5.5
Effective Tax Rate (%)	58.00	56.00	56.00	54.0	51.0
Net Income	214.4	439.8	922.1	922.1	856.2
Shares Outstanding, Millions	2,732.5	2,939.4	3,074.6	3,172.5	3,206.1
Per Share Data					
Earnings	0.07	0.15	0.29	0.28	0.25
Dividend	0.05	0.06	0.06	0.07	0.07
Book Value	1.36	1.77	2.23	1.68	1.82
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Toshiba Corporation
Annual Reports
Dataquest (January 1992)

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Table 5
Consolidated Balance Sheet
Fiscal Year Ending in March
(Billions of Yen)

Balance Sheet	1987	1988	1989	1990	1991
Cash	204.1	508.2	636.7	1,018.7	847.1
Receivables	671.9	721.0	883.1	1,019.3	1,170.4
Marketable Securities	204.9	194.6	171.1	189.2	194.0
Inventory	536.6	742.7	825.2	960.0	1,102.6
Other Current Assets	184.0	184.1	206.9	255.1	265.8
Total Current Assets	1,969.7	2,350.7	2,723.0	3,442.3	3,579.9
Net Property, Plants	744.5	737.9	789.8	905.6	1,117.7
Other Assets	569.9	607.4	692.9	833.4	832.7
Total Assets	3,284.1	3,696.0	4,205.7	5,181.3	5,530.3
Total Current Liabilities	1,834.5	2,073.0	2,437.1	2,756.7	2,924.9
Long-Term Debt	729.0	778.8	770.4	1,204.8	1,286.8
Other Liabilities	127.7	126.3	117.8	134.0	140.0
Total Liabilities	2,691.2	2,978.1	3,325.3	4,095.5	4,351.7
Converted Preferred Stock	0	0	0	0	0
Common Stock	151.8	196.6	229.7	261.7	271.8
Other Equity	149.2	205.6	242.9	337.2	349.6
Retained Earnings	291.9	315.7	407.8	486.9	557.2
Total Shareholders' Equity	592.9	717.9	880.4	1,085.8	1,178.6
Total Liabilities and Shareholders' Equity	3,284.1	3,696.0	4,205.7	5,181.3	5,530.3
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Toshiba Corporation
Annual Reports
Dataquest (January 1992)

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Table 6
Consolidated Income Statement
Fiscal Year Ending in March
(Billions of Yen, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	3,307.6	3,572.4	3,800.9	4,252.0	4,695.4
Japanese Revenue	2,287.0	2,466.0	2,582.1	2,582.1	2,582.1
Non-Japanese Revenue	1,020.6	1,106.4	1,218.8	1,344.3	1,454.8
Cost of Sales	2,428.5	2,572.9	2,584.2	2,864.0	3,178.5
R&D Expense	201.1	217.4	230.4	265.9	299.0
SG&A Expense	827.5	889.4	968.7	1,072.1	1,254.8
Capital Expense	213.3	187.7	267.6	323.5	440.9
Pretax Income	78.0	125.5	234.8	269.7	258.9
Pretax Margin (%)	2.4	3.5	6.2	6.3	5.5
Effective Tax Rate (%)	58.0	56.0	56.0	54.0	51.0
Net Income	34.2	60.7	119.4	131.8	120.9
Shares Outstanding, Millions	2,732.5	2,939.4	3,074.6	3,172.5	3,206.1
Per Share Data					
Earnings	11.86	20.37	37.27	40.11	35.72
Dividend	8.00	8.00	8.00	10.00	10.00
Book Value	216.98	244.23	286.35	342.3	367.6
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Toshiba Corporation
Annual Reports
Dataquest (January 1992)

Table 7
Key Financial Ratios
Fiscal Year Ending in March

Key Financial Ratios	1987	1988	1989	1990	1991
Liquidity					
Current (Times)	1.07	1.13	1.12	1.25	1.22
Total Assets/Equity (%)	553.90	514.83	477.70	477.19	469.23
Current Liabilities/Equity (%)	309.41	288.76	276.82	253.89	248.17
Total Liabilities/Equity (%)	453.90	414.83	377.70	377.19	369.23
Profitability (%)					
Return on Assets	1.04	1.64	2.84	2.54	2.19
Return on Equity	5.77	8.46	13.56	12.14	10.26
Profit Margin	1.03	1.70	3.14	3.10	2.57
Other Key Ratios					
R&D Spending % of Revenue	6.08	6.09	6.06	6.25	6.37
Capital Spending % of Revenue	6.45	5.25	7.04	7.61	9.39
Employees	121,000	122,000	125,000	142,000	162,000
Revenue (¥M)/Employee	27.34	29.28	30.41	29.94	28.98
Capital Spending % of Assets	6.49	5.08	6.36	6.24	7.97
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Toshiba Corporation
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Unisys Corporation

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Dun's Number: 00-535-8932

Date Merged: September 16, 1986

CORPORATE STRATEGIC DIRECTION

Unisys Corporation was formed in 1986 by the merger of Sperry and Burroughs. The company designs, manufactures, markets, and supports commercial, defense, and other information processing equipment and related software.

Unisys manufactures computers ranging from workstations (PCs) through mainframes and is also a supplier of defense electronics. The Information Systems and Related Services and Suppliers category constitutes the largest portion of Unisys' operations. The company's target market emphasis is on organizations such as airlines, banks, telephone companies, and government agencies that deliver a high volume of services in environments where transactions occur constantly at high speeds.

Revenue for both 1989 and 1990 was $10 billion.* Excluding favorable foreign currency effects, revenue in 1990 would have been down slightly. Revenue growth in defense was offset by a decline in commercial operations. The company had a net loss of $436.7 million for 1990, compared with a net loss of $639.3 million for 1989. The loss for 1990 is attributed to the weakened U.S. commercial computer market, conditions in the Middle East, and a special charge of $181 million taken in the third quarter of 1990 to cover reductions in the work force (the elimination of 5,000 jobs) and operational consolidations. As of December 31, 1990, Unisys had approximately 75,300 employees.

In July 1991, Unisys announced that it was taking a series of actions to accelerate a return to profitability. These actions were: streamline the product line in conformance with the Unisys architecture; reduce the number of market segments the company serves directly; sharply focus resources only where the company can add value and differentiation; and aggressively seek technology and marketing alliances to complement in-house strengths on the most cost-efficient basis.

As a result of these fundamental changes, and in light of the continued computer industry weakness, Unisys took special charges of $1.2 billion in the second quarter, which ended June 30, 1991. The charges included $925 million for restructuring to cover a planned work force reduction of approximately 10,000 employees, product and market segment pruning, and plant and excess facilities consolidation. The charges also include $275 million to cover a write-down of goodwill and a write-off of an investment in Memorex preferred stock. The company expects to reduce overall costs by $800 million on an annual basis by December 31, 1992.

In September 1991, Unisys sold its Timeplex Inc. networking subsidiary to a joint venture led by Ascom Holding AG of Switzerland for $207 million. Timeplex developed wide area networking and Enterprise Networking. It offered a full range of wide area and local area internetworking systems for the transmission of voice data and video. Timeplex and Unisys plan to maintain their joint marketing relationship.

In October 1991, Unisys announced that it intends to sell all of its interest in its Defense Systems business through an initial public offering to Paramax Inc., one of the leading U.S. defense electronics companies, headquartered in McLean, Virginia. A registration statement covering 20 million shares of common stock has been filed with the Securities and Exchange Commission. The anticipated price range for the common stock, as set forth in the registration statement, is $22 to $25 per share. In addition, Unisys will receive

*All dollar amounts are in U.S. dollars.

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$332 million in cash from Paramax Inc. The completion of the offering is subject to a number of conditions including regulatory approvals, financing, and market conditions.

Although there has been a multitude of changes that have occurred, there has been no fundamental change in the strategic direction. Unisys intends to specialize in providing mission-critical business solutions on open information networks and to focus resources on servicing and increasing revenue from its large established customer base. Unisys plans to pursue new business growth in four primary market segments: financial services, airlines, communications, and the public sector. The product lines being focused on are the 2200 and A Series Information Hub mainframes, Intel-based servers and workstations (PCs), and check and office imaging systems.

The R&D investment costs for fiscal year 1990 were $746.5 million, a decrease of 4 percent from 1989. R&D expenditure was 7.39 percent of revenue for fiscal 1990, compared with 7.74 percent of revenue for 1989.

Unisys sells its products and services worldwide, primarily through its direct sales force. Unisys also uses OEMs and value-added resellers (VARs) as well as distributors in some foreign countries. During fiscal 1990, Unisys had operations in approximately 100 countries. Revenue generated domestically was 487 percent and international was 52 percent. International sales are generated from the Asia/Pacific, Europe, and Central and South America markets.

After several years of collaboration, Unisys and five other computer companies from the United States and Europe formed a consortium to develop and promote an open system for exchanging electronic documents. The objective of the Open Document Architecture (ODA) consortium is to come up with a software tool kit that conforms to the ODA standard. The kit is expected to be available in 1993 and will be licensed to other computer companies and systems developers.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by geographic region. Information on revenue by distribution channel is not available. Tables 3 through 5 at the end of this backgrounder provide comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Unisys has two main business segments: Commercial Information Systems and Services and Defense Systems. Within these two business segments, Unisys classifies the majority of its products under the category called Information Systems and Related Services and Suppliers. This category represents more than 90 percent of consolidated revenue, operating profit, and identifiable assets during fiscal 1990.

The Information Systems and Related Services and Suppliers category has six specific product classes: Mainframes and Peripherals, Departmental Servers and Workstations (PCs), Software and Related Services, Equipment Maintenance, Custom Products and Services, and Other.

Information Systems and Related Services and Suppliers

Computer Systems

Mainframes and Peripherals comprise a complete line of small-to-large mainframes and related communications processors and peripheral products, such as printers, storage devices, and document-handling equipment. This class of products contributed more than $2.9 billion, or 29 percent of total revenue, for fiscal 1990. According to Dataquest, Unisys ranked seventh in the mainframe market with a 3.90 percent market share, compared with 5.26 percent for 1989. In the midframe market, Unisys ranked fourth with a 5.27 percent market share, compared with a 5.39 percent market share for 1989.

Departmental Servers and Workstations (PCs) accounted for 14 percent of total revenue or more than $1.4 billion for fiscal 1990. This class is made up of departmental servers and workstations including distributed systems, intelligent workstations (PCs), and UNIX OS-based equipment and terminals.

Software and Related Services consists of application and systems software with related professional services. This product class generated more than $2 billion, or 20 percent of total revenue, for fiscal 1990.

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Representing 20 percent of total 1990 revenue, Equipment Maintenance provides clients with preventive maintenance, spare parts, and other repair activities. This class constituted approximately $2 billion in revenue for fiscal 1990.

Custom Products and Services, which includes specialized information processing systems marketed mainly to governmental defense agencies, contributed 16 percent of total revenue, totaling approximately $1.6 billion in sales.

The Other class generated 1 percent of revenue, or approximately $185.3 million.

Unisys' Network Applications Platform (NAP) is a digital telephone switch that has been directly integrated with a mainframe system. The NAP runs on a full range of A Series models and enables telephone companies to offer customers advanced intelligent services that require mainframe storage capacity.

The A Series processors are descendants of the B5000 introduced in the early 1960s. The A Series product family is divided into four subfamilies of processors aimed at the needs of desktop, entry-level, midrange, and large-scale commercial data-processing customers. The Micro A, a multiuser desktop system, runs on the same operating system as the other members of the A Series. Housed in a Unisys PW personal computer, the Micro A runs the same software as other A series models and can be used to test and develop applications quickly for use on larger systems. The A10x models provide midrange performance with a larger selection of peripheral connectivity. The A12, A15x, A16, A17, and A19 field-upgradable models make up the large-scale systems.

The 1100/2200 Series is positioned as an information hub in a tiered integrated information environment. The goal is to support a new generation of computer applications using client/server technology to take advantage of the various attributes of information hubs and high-powered microprocessor-based workstations (PCs).

The 1100/2200 Series is broken into four subfamilies: the 2200/100 Series, which consists of entry-level systems; the 2200/400 Series, which consists of medium-scale systems; the 2200/600 Series, which consists of large-scale systems; and the 2200/900 Series, which consists of high-end systems. The 1100/2200 Series is primarily targeted at the airline, communications, and government markets.

InfoImage Image Item Processing System/Image Check Processing System (IIPS/ICPS) is based on Unisys' V Series mainframes and DP 1800 document processors. Through the elimination of many manual steps involved in processing checks, the system allows customers to cut labor expenses while doubling the number of checks they can process each hour.

InfoImage Engineering Document Management System (EDMS) runs on Unisys' UNIX-based systems and PW workstations. The system captures large documents, such as engineering drawings and facilities diagrams, which can be displayed, edited, and distributed electronically, reducing paperwork during design review cycles.

In April 1990, Unisys unveiled InfoImage Folder, an electronic file folder management system that automates and expedites the movement of paper-based information. Electronic files are handled in the same manner as paper files: Files are organized into folders that can hold many documents, each of which can have many pages. InfoImage Folder has menu-driven programs that enable the user to define form displays, map data to and from files on mainframes and other computers in the network, develop indexing routines, and automate document distribution.

Unisys BTOS/CTOS workstations are multitasking, allowing users to execute many tasks at the same time. They offer a modular architecture and built-in LAN capabilities so that users can build LANs of workstations quickly and without incurring costs for additional equipment. These LANs can be connected to users' central mainframes without sacrificing the processing power available to individual users. There are over 850,000 BTOS/CTOS systems installed.

UNIX

The Unisys U Series are business-oriented UNIX computers that run under an implementation of AT&T's UNIX System V. These systems act as "servers" in LANs, coordinating the flow of information between large-scale mainframe systems and smaller

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desktop systems. The U 5000 Series is based on the Motorola 68020 processor; the U 6000/30, 50, and 55 are Intel 80386-based systems manufactured by Network Computer Group, a wholly owned subsidiary.

Early in 1990, Unisys announced a series of broadband networking systems, which include the TX3/SuperHub and TIME/LAN family systems based on fiber-distributed data interface. Through fiber-optic technology, the TIME/LAN systems offer increases in working capacity that customers need to consolidate their LANs and to support high-speed, high-bandwidth applications such as imaging and videoconferencing. The TX3/SuperHub provides 28 times the capacity of T-1 systems and offers customers platforms to build super transport backbone networks.

Unisys also markets DCP and CP families of front-end network processors, concentrators, and gateways. These systems consolidate, format, and transmit data among workstations, departmental servers, and mainframes.

UNIX systems offer users a powerful platform to perform standalone tasks as well as connect into broader cooperative networks. More than 1,000 commercial UNIX applications run on Unisys' U Series systems.

Software

Unisys offers a wide range of software packages tailored for specific industries including banking, health care, manufacturing, and airlines. By supporting standard operating systems on its platforms and maintaining relationships with third-party software developers, the company also gives its customers access to off-the-shelf applications available on the general market.

Unisys' computer-aided software engineering (CASE)/fourth-generation language (4GL) tools—the Logic and Information Network Compiler (LINC), Maintaining, Preparing, Producing Executive Reports (MAPPER), and Ally systems—automate the software development process, decreasing development time and freeing organizations to concentrate on designing new systems that solve business problems. LINC and MAPPER are available on all major Unisys product platforms. Unisys has added "upper-CASE" system design capabilities to the LINC system as well, and extended the use of its software tools to outside developers whose upper-CASE technologies are widely used throughout the industry.

Defense Systems

Mil/Aero

The Defense Systems segment provides defense electronics through five major lines: shipboard and ground systems, systems development, communications systems, system support, and computer systems. However, as stated in the "Corporate Strategic Direction" section, Unisys is in the process of divesting itself from this line of business to focus on its Commercial Information Systems and Services.

Further Information

For further information about Unisys' business segments, please contact the appropriate Dataquest industry services.

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Table 1
Five-Year Corporate Highlights (Millions of U.S. Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	7,432	9,713	9,902	10,097	10,111
Percent Change	67.79	30.69	1.95	1.97	0.14
Capital Expenditure	550	836	854	811	670
Percent of Revenue	7.40	8.61	8.62	8.03	6.63
R&D Expenditure	441	597	713	782	747
Percent of Revenue	5.93	6.15	7.20	7.74	7.39
Number of Employees (K)	98	93	93	82	75
Revenue ($K)/Employee	75.84	104.44	106.47	122.69	134.81
Net Income	(248)	578	681	(639)	(437)
Percent Change	(117.32)	1,444.19	17.82	(193.88)	(31.64)

1990 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	2,306	2,471	2,400	2,934
Quarterly Profit	(3.2)	11.8	(356.8)	(88.5)

Source: Unisys Corporation
Annual Reports and Forms 10-K
Dataquest (November 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
North America	57.10	56.40	54.20	50.90	48.20
International	42.90	43.60	45.80	49.10	51.80

Source: Unisys Corporation
Annual Reports and Forms 10-K
Dataquest (November 1991)

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1990 SALES OFFICE LOCATIONS

North America—200
Europe—1 (sales subsidiary only)
Asia/Pacific—7 (sales subsidiary only)
ROW—10 (sales subsidiary only)

MANUFACTURING LOCATIONS

North America

Camarillo, California
Air traffic control systems, custom systems, development of Thailand's centralized air defense system
Eagan, Minnesota
Standard militarized computer products and displays, information-processing systems, Submarine Standard Operating Systems
Flemington, New Jersey
Personal computers
Great Neck, New York
Electronic warfare, military systems, and support systems
Mission Viejo, California
Low-end A Series
Plymouth, Michigan
Imaging, check reader/sorters
Rancho Bernardo, California
Low-end A Series
Roseville, Minnesota
2200 Series systems, military computers
Salt Lake City, Utah
UNIX

Europe

Barcelona, Spain
AI equipment
Villers-Ecalles, France
Financial terminals

Asia/Pacific

Jurong, Singapore
Terminals
Milson's Point, Australia
Software

ROW

Veleiros, Brazil
Low-end A Series systems

SUBSIDIARIES

North America

Convergent Inc. (United States)
Unisys Canada Inc. (Canada)
Unisys Finance Corporation (United States)
Unisys International Company (United States)

Europe

Unisys Belgium (Belgium)
Unisys Deutschland GmbH (Germany)
Unisys Espana S.A. (Spain)
Unisys France (France)
Unisys Italia S.p.A. (Italy)
Unisys Limited (United Kingdom)
Unisys Netherland N.V. (Netherlands)
Unisys (Schweiz) A.G. (Switzerland)

Asia/Pacific

Unisys Australia Limited (Australia)

ROW

Unisys Eletronica Ltda. (Brazil)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Timeplex Inc.
Unisys sold Timeplex Inc. to Ascom Holding AG of Switzerland. However, the companies plan to maintain joint marketing relationship.

1990

Unisys did not participate in any alliances, joint ventures, or licensing agreements during 1990.

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1989

FileNet
FileNet signed an agreement under which FileNet will provide Unisys with its Image Access Facility software and jukeboxes.

Touche Ross
Unisys and Touche Ross have agreed to a strategic alliance to provide large-scale commercial systems integration services.

Mercedes Information Technologies (Pty) Ltd.
Unisys sold its South African marketing and sales subsidiary to Mercedes Information Technologies.

Lodgistix Inc.
The two companies have a marketing alliance that makes Lodgistix a VAR of the Unisys PW2 line of products in conjunction with its MS-DOS-based property management system and sales and catering system.

Microamerica
Unisys signed a value-added distributor agreement with Microamerica. The agreement is expected to increase Unisys sales of UNIX-based multiuser systems and PCs through the third-party channel over the next five years significantly.

Tech Data Corp.
Unisys signed a value-added distribution arrangement with Tech Data. Under the agreement, Tech Data will resell Unisys' Intel 80386-based U 6000 Series of UNIX processors and the PW2 line to its customers.

SPSS Inc.
Unisys and SPSS agreed to a strategic alliance to provide statistical and graphics software solutions on Unisys hardware.

1988

Mitsui & Co.
The two companies entered into a joint venture to form Nihon Unisys Ltd.

MERGERS AND ACQUISITIONS

1990

Unisys made no mergers or acquisitions during 1990.

1989

Unisys made no mergers or acquisitions during 1989.

1988

Convergent Inc.
Convergent, acquired by Unisys, was a leader in distributed and networking solutions.

Timeplex Inc.
Timeplex was acquired by Unisys.

KEY OFFICERS

James A. Unruh
Chairman and chief executive officer

Reto Braun
President and chief operating officer

Hugh Lynch
President, Computer Systems & Products Group

PRINCIPAL INVESTORS

Information is not publicly available.

FOUNDERS

Information is not publicly available.

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Table 3
Balance Sheet
Fiscal Year Ending December 31
(Millions of U.S. Dollars)

Balance Sheet	1986	1987	1988	1989	1990
Cash	56	55	26	9	403
Receivables	1,807	2,915	2,785	2,698	2,366
Marketable Securities	0	0	0	0	0
Inventory	1,952	1,856	2,484	1,761	1,458
Other Current Assets	722	508	521	615	642
Total Current Assets	4,537	5,334	5,816	5,083	4,869
Net Property, Plants	2,192	1,858	2,003	1,855	1,709
Other Assets	2,680	3,399	3,716	3,813	3,711
Total Assets	9,409	10,591	11,535	10,751	10,289
Total Current Liabilities	3,342	3,666	3,432	3,537	4,210
Long-Term Debt	2,226	2,377	3,078	3,248	2,495
Other Liabilities	13	3	70	84	99
Total Liabilities	5,581	6,046	6,580	6,869	6,804
Converted Preferred Stock	1,432	1,426	1,429	1,429	1,578
Common Stock	231	747	797	797	810
Other Equity	486	355	294	126	196
Retained Earnings	1,679	2,017	2,435	1,530	901
Total Shareholders' Equity	3,828	4,545	4,955	3,882	3,485
Total Liabilities and Shareholders' Equity	9,409	10,591	11,535	10,751	10,289

Source: Unisys Corporation
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Table 4
Consolidated Income Statement
Fiscal Year Ending December 31
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1986	1987	1988	1989	1990
Revenue	7,432	9,713	9,902	10,097	10,111
U.S. Revenue	4,244	5,476	5,368	5,136	4,871
Non-U.S. Revenue	3,188	4,237	4,534	4,961	5,240
Cost of Sales	5,118	5,639	5,589	6,816	6,600
R&D Expense	441	597	713	782	747
SG&A Expense	1,905	2,378	2,527	2,710	2,720
Capital Expense	550	836	854	811	670
Pretax Income	(89)	951	959	(554)	(337)
Pretax Margin (%)	(1.20)	9.79	9.68	(5.49)	(3.33)
Effective Tax Rate (%)	NA	NA	NA	NA	NA
Net Income	(43)	578	681	(639)	(437)
Shares Outstanding, Millions	138	149	159	158	162
Per Share Data					
Earnings	(0.54)	2.93	3.27	(4.71)	(3.45)
Dividend	0.87	0.91	0.98	1.00	0.50
Book Value	27.74	30.50	31.16	24.57	21.51

NA = Not available

Source: Unisys Corporation
Annual Reports and Forms 10-K
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Table 5
Key Financial Ratios
Fiscal Year Ending December 31

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	1.36	1.45	1.69	1.44	1.16
Total Assets/Equity (%)	57.26	40.88	40.42	47.78	49.04
Current Liabilities/Equity (%)	87.30	80.66	69.26	91.11	120.80
Total Liabilities/Equity (%)	145.79	133.03	132.80	176.93	195.24
Profitability (%)					
Return on Assets	(0.46)	5.46	5.90	(5.95)	(4.25)
Return on Equity	(1.12)	12.72	13.74	(16.47)	(12.54)
Profit Margin	4.93	5.95	6.88	(6.33)	(4.32)
Other Key Ratios					
R&D Spending % of Revenue	5.66	6.15	7.20	7.74	7.39
Capital Spending % of Revenue	7.40	8.61	8.62	8.03	6.63
Employees (K)	98	93	93	82	75
Revenue ($K)/Employee	75.84	104.44	106.47	122.69	134.81
Capital Spending % of Assets	5.85	7.89	7.40	7.54	6.51

Source: Unisys Corporation
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