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Introduction to the Service

DEFINITION OF THE SERVICE

The CAD/CAM Industry Service (CCIS) is a comprehensive, worldwide information service that performs research on and analyses of the markets, companies, products, trends, and technologies of the CAD/CAM industry. CCIS provides research and decision support in five ways:

- Research notebooks. These notebooks are detailed, frequently updated reference sources on the CAD/CAM industry. Market forecasts and analyses, annual shipments, market shares, and installed base information are provided. Profiles of major competitors are also included.
- Inquiry privilege. This feature provides clients with direct access to the CCIS research analysts. The inquiry privilege allows clients to access the information most applicable to their specific needs.
- Research bulletins. These event-driven publications provide a continual flow of timely information and Dataquest analyses on major industry events and issues.
- Industry conference. An annual conference brings industry participants together to review the state of the CAD/CAM industry and discuss the major issues in an open forum.
- Research library. Clients have access to Dataquest's extensive libraries for independent research.

To support client's decision-making in such areas as developing long-term goals, implementing and executing tactical plans, understanding user environments, and evaluating distribution channels, CCIS offers the following types of information:

- Comprehensive information on markets, products, technologies, applications, and companies in the CAD/CAM industry
- Quantitative data on shipments, installed bases, forecasts, market segmentation, and company performance
- Qualitative insights on technology trends, new product and market developments, company and marketing strategies, product positioning, and competitive postures

NEED FOR THE SERVICE

As the CAD/CAM industry matures, with the compound annual growth rate (CAGR) slowing to 8 percent in 1991, the decision-making process of CAD/CAM professionals becomes increasingly complex. Dataquest's CAD/CAM Industry Service is a resource of industry experts, providing all levels of personnel at our client companies with information and analyses on the CAD/CAM industry so that decisions can be made in an informed and timely manner.

Both general and specific industry data are gathered from a wide variety of sources. The benefits to our clients include:

- A single-source resource for decision-making support in planning, marketing, and development
- An objective, broad coverage of interrelated and international markets
- An external management information source
- A dynamic, ongoing, and long-term relationship
- A decision support tool for tactical and strategic information needs and problems

SERVICE STRUCTURE

CCIS research and analysis is offered to clients in two major parts: core (or general) and application-specific. Refer to Figure 1 for a graphical description of the service structure.

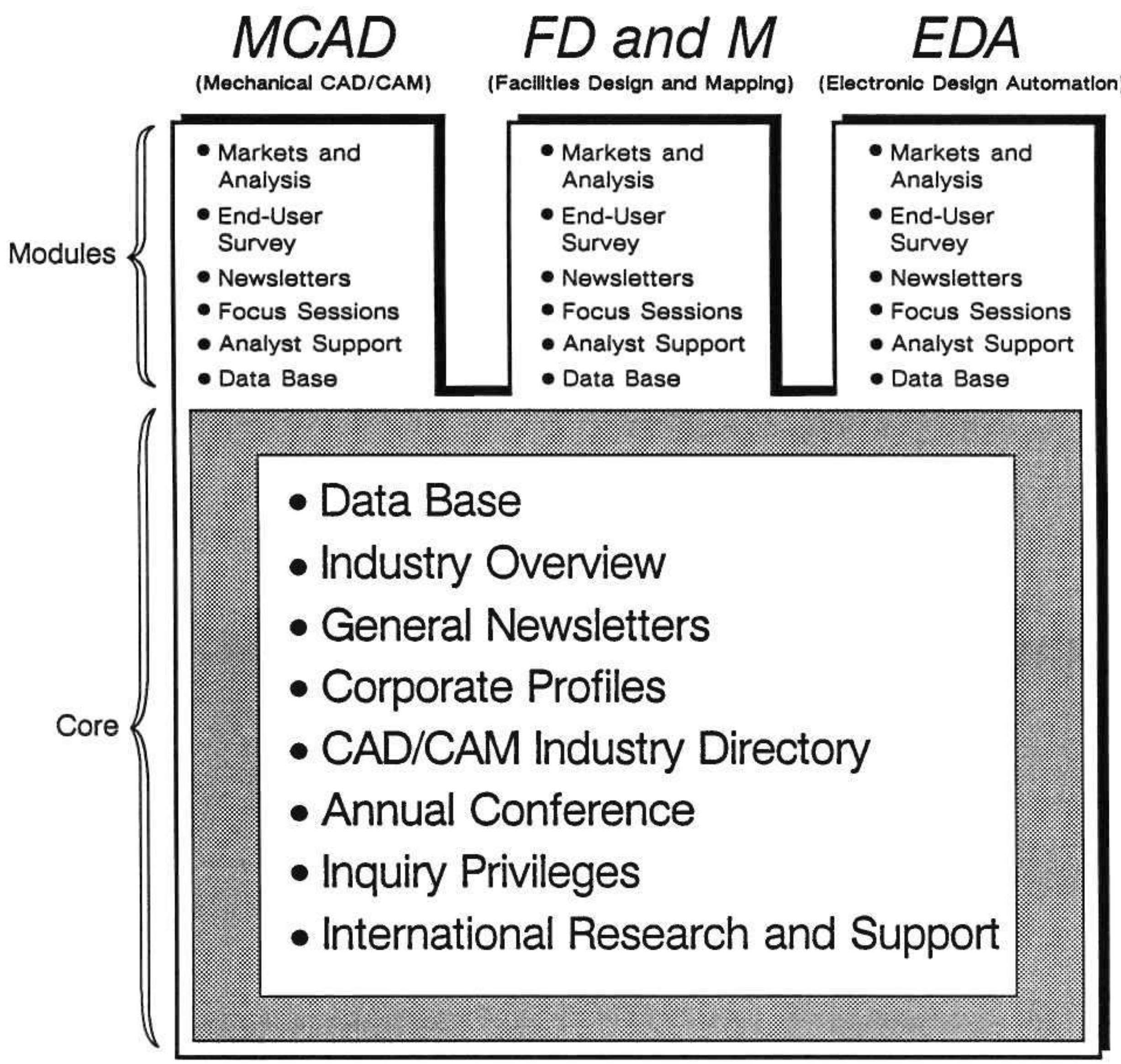
Core Service

The core service is provided to all CCIS clients and contains information and analyses relevant to all CAD/CAM industry participants. The core service is supported by a staff of industry and research experts. It consists of the following elements:

- *Industry Overview*—Analysis of the industry as a whole, including summaries of the major CAD/CAM segments
- *Company Profiles*—Information on the top 20 CAD/CAM suppliers, as well as quarterly and annual financial data on publicly held companies
- *Newsletters*—Event-driven analyses of issues and research of relevance to all CCIS clients

Figure 1

CAD/CAM Industry Service Structure



Source: Dataquest
June 1987

In addition to the above elements, all CCIS clients receive through the core service the following elements:

- Inquiry privileges—Direct access to the CCIS staff of analysts and researchers so that data and analysis may be tailored to specific information requests

- Attendance to the annual industry conference—One free seat at the conference, which must be reserved in advance

- International support—Access to the CCIS staff of researchers in Dataquest's London and Tokyo offices, as well as analysis pertaining to those regions

- *CAD/CAM Industry Directory*—One copy of the annually updated directory, which contains pertinent information on over 600 CAD/CAM suppliers and their products

Application-Specific Modules

The application-specific notebooks are available to CCIS clients that need information on a specific CAD/CAM application.

- *Mechanical CAD/CAM Applications*

- *Electronic Design Automation Applications*

- *Facilities Design and Mapping Applications*

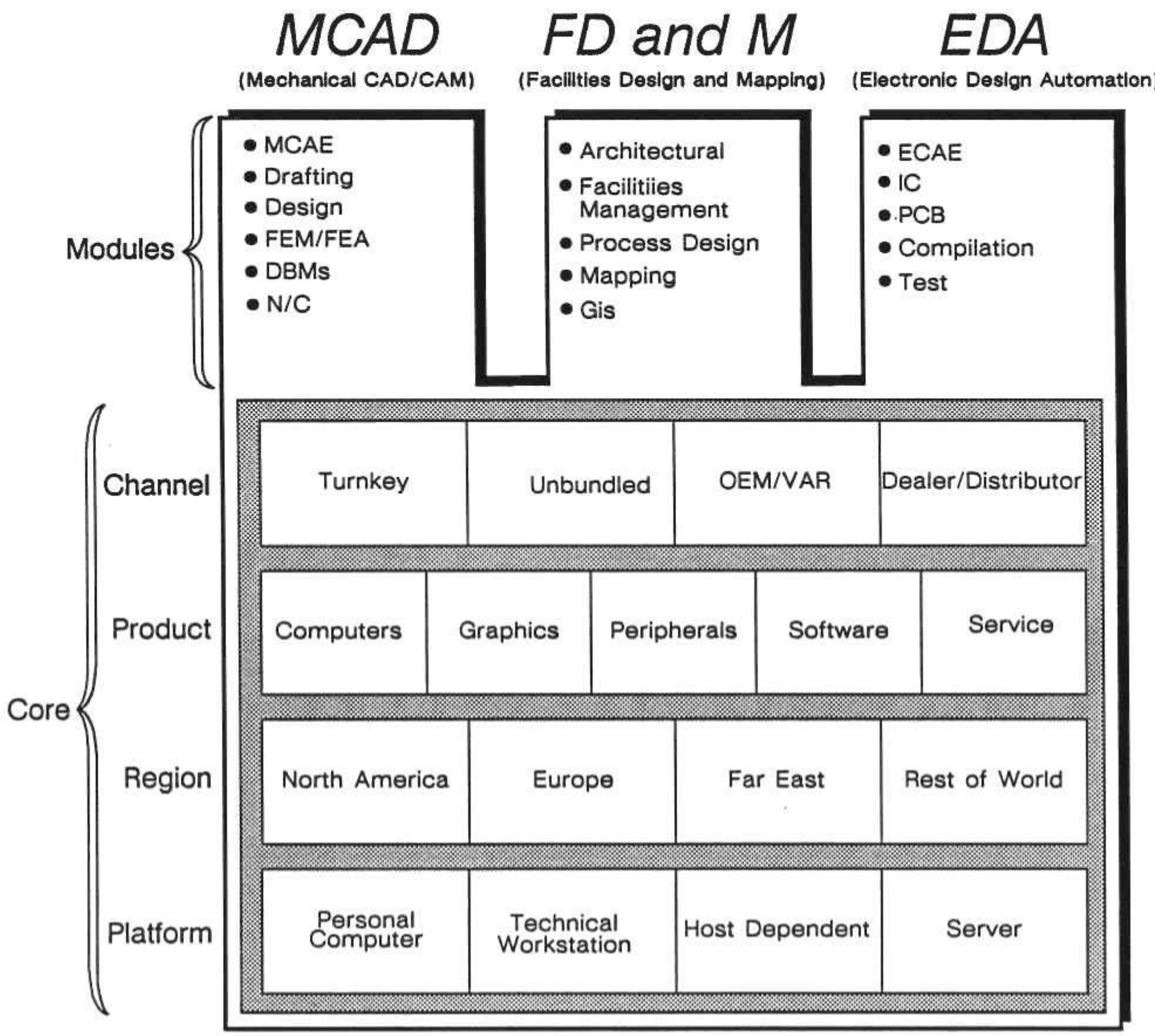
Each application module contains information and analyses particular to the specific application, including newsletters and other event-driven publications, market overview, market shares and forecasts, and specialized research and surveys. Each application module is supported by a staff of CCIS analysts with experience in the specific application.

INFORMATION STRUCTURE

The information available to CAD/CAM Industry Service clients is structured to provide data and analysis that are easily accessible and meaningful. Figure 2 graphically illustrates the CAD/CAM Industry Service information and reporting structure. All core segments, such as channel, product, region, and platform, are analyzed in both a general sense, which can be found in the *Industry Overview* core notebook, and an application-specific sense, which can be found in the respective application modules.

Figure 2

CAD/CAM Industry Service Information Structure



Source: Dataquest
June 1987

Channel

Channel, the first tier of the data base model, identifies how CAD/CAM systems reach the end user. This tier helps to distinguish the various distribution channels and marketing arrangements used when selling CAD/CAM systems.

Turnkey

The turnkey channel encompasses the sale of complete CAD/CAM systems, including computer, graphics workstations, operating systems, application software, and peripherals. Turnkey vendors also typically offer complete service, training, and maintenance for the systems that they sell.

Unbundled

The unbundled channel comprises the sale of CAD/CAM system components, such as application software or hardware, sold independently of each other. Unbundled components may be sold by either a company that specializes in that particular component, such as a software-only company or a computer manufacturer, or by a turnkey vendor, selling its software independently of the system.

OEM/VAR

The original equipment manufacturer (OEM) and value-added reseller (VAR) channel consists of companies that sell their products to another company for resale, which may be to another tier in the distribution channel or to the ultimate end user. Companies in this tier include computer manufacturers that sell their systems to turnkey vendors, who in turn resell the computer to an end user.

Dealer/Distributor

This growing channel consists of a group of companies that resell products developed by another company. Although not limited to personal computers, this platform comprises the majority of products moved through this channel. Dataquest reports on the amount of products moved through this channel but does not measure the market share of individual dealers or distributors.

Product

The product tier deals with tracking the sale of five major subsystems of a CAD/CAM system, including computers, graphics terminals, peripherals, software, and service.

Computers

This area identifies the unit and dollar volume of computer sales in the CAD/CAM industry.

Graphics Terminals

This area identifies the unit and dollar volume of graphics terminal sales in the CAD/CAM industry.

Peripherals

This area identifies the dollar volume of sales of peripherals such as plotters and printers in the CAD/CAM industry.

Software

This area identifies the dollar volume of application software sales in the CAD/CAM industry.

Service

This area identifies the dollar value of hardware, software, and support service sales in the CAD/CAM industry.

Region

The regional segment of the CAD/CAM Industry Service data base defines four regions into which CAD/CAM systems are sold. This segmentation aids in understanding the geographic characteristics of the areas where CAD/CAM systems are sold and delivered.

North America

The North American segment includes sales of CAD/CAM systems in the United States, Canada, and Mexico.

Europe

Europe includes the sale of CAD/CAM systems into the following countries and European areas:

- Benelux countries
- France
- German Region
- Italy
- Scandinavian countries
- United Kingdom
- Rest of Europe

Far East

The Far Eastern region includes the sale of CAD/CAM systems into the following countries:

- Hong Kong
- Japan
- Korea
- People's Republic of China (PRC)
- Singapore
- Taiwan

Rest of World

The Rest of World (ROW) segment includes the sale of CAD/CAM systems from territories not included in the European, Far Eastern, or North American regions.

Platform

Platform segmentation identifies three major architectures being delivered into the CAD/CAM market. This segmentation aids in understanding the trends related to the types of systems being purchased.

The three types of products are personal computers, technical workstations, and host-dependent systems. The major distinction among these product types is that personal computers and technical workstations contain their own CPUs and operating systems and therefore are classified as being fully distributed systems. Host-dependent systems, however, are considered shared-logic systems because their CPUs and operating systems are used as shared resources. For counting purposes, Dataquest treats personal computers and technical workstations as both system units and workstation units.

Personal Computers

A personal computer-based workstation is defined as having the following characteristics:

- DOS or OS/2 operating system
- Local 8/16-bit CPU
- Single processing capability

Examples of personal computer-based workstations are the Apple Macintosh and the IBM PC AT.

Technical Workstations

A technical workstation is defined as having the following characteristics:

- Resident operating system
- Full virtual operating system, such as UNIX or VMS
- Multitasking
- Networked communications support
- Integrated graphics

Examples of technical workstations are Apollo's DN 3000, Daisy's Logician, Intergraph's Interpro 32, and Sun's 2/120.

Host-Dependent

The host-dependent architecture is defined as having the following characteristics:

- CPU external from the workstation
- No local operating system at the workstation level
- Conditioned environment requirements

Examples of host-dependent products are Computervision's CDS 4000, Digital's VAX 11/780, and IBM's 4361.

Server

A server is defined as a networked resource that is used to control or accelerate a process, such as a file or peripheral server, so that more than one user may access a shared resource, or it can be used as an accelerator. A server is also typically used as a shared resource to speed up a computationally-intense process.

COMPANIES

Dataquest continues to expand the number of companies included in our forecast model. Our data base includes only end-user revenue of CAD/CAM companies. In this way, we avoid double counting and accurately represent CAD/CAM purchases by ultimate end users. The model consists of two groups of companies: those listed individually, or "main companies," and those consolidated into the "other" category. A company is listed individually only if its total CAD/CAM end-user revenue is $15 million or more. Conversely, a company is in the "other" category if its total CAD/CAM end-user revenue is less than $15 million.

Main Companies

The following companies, whose end-user revenue is $15 million or more, are listed individually in Dataquest's forecast model:

- Apollo
- Applicon
- Auto-Trol
- Autodesk
- CISI
- Cadnetix
- Calay
- Calcomp
- Calma
- Cimlinc
- Computervision
- Control Data
- Daisy
- Digital
- Exapt
- Ferranti
- Fujitsu
- Futurenet
- Gerber Systems
- Graftek
- Hewlett-Packard
- Hitachi

- Hitachi Zosen
- Holguin
- IBM
- Intergraph
- MacNeal-Schwendler
- Matra Datavision
- McDonnell Douglas
- Mentor
- Mitsubishi Electric
- Mutoh Industries
- NEC
- Norsk
- Otsukashokai
- Pafec
- Prime
- Racal-Redac
- Robo Systems
- SDRC
- Scientific Calculations
- Seiko I&E
- Sharp System Products
- Siemens
- Silvar-Lisco
- Sun
- Synercom
- Syscan
- Tektronix
- Telesis
- Toshiba
- Valid
- Zuken
- Zycad

Other North American Companies

These companies, whose end-user revenue is less than $15 million, are based in North America and are in the "other" category:

- A/SA
- ACDS
- Accugraph
- Advanced Geographic Systems
- Aptos
- Automated Systems
- Cadam
- Caeco
- Cascade Graphics
- Case Technology

- Cubicomp
- DFI
- DeNies
- ECAD
- ESRI
- Engineered Software
- Evans & Sutherland
- Factron
- Foresight Resources
- Gateway Design Automation
- Genrad
- Geobased Systems
- Geovision
- Gerber Scientific
- HHB Systems
- HOK/CSC
- Holguin
- ICAD
- Infinite Graphics
- Kork Systems
- LSI Logic
- MAGI
- MARC
- Manufacturing Consultants
- Maptech
- Megacad
- Metasoftware
- Metheus
- Micro Control Systems
- NCA
- Orcad
- PDA Engineering
- Paragon
- Personal CAD
- Phoenix Data Systems
- Point Line Company
- Quadtree
- SDA
- Seattle Silicon Technology
- Secagraphics
- Shape Data
- Sigma Design
- Silicon Compilers
- Silicon Design Labs
- Silicon Solutions
- Simucad
- Shok Systems
- Sperry

- Supercad
- Swanson Analysis
- Teradyne
- Test Systems Strategies
- The Great Softwestern Co.
- Transformer CAD
- Unicad
- VLSI Technology
- Versacad
- Via Systems
- View Logic
- Visionics
- WPS Development
- Xerox

Far East-Based Companies

Dataquest collects information on the following Japanese companies. If a company does not represent a United States-based company's Japanese distributor and if its total end-user CAD/CAM revenue is $15 million or more, it is also included in the "main companies" category. This list represents all of the Far Eastern companies from which Dataquest's CCIS collects data:

- Aida Engineering
- Andor
- Asahi Optical
- Asahig Giken
- Autodesk Japan
- C. Itoh Techno-Science
- CPU
- Century Research Center
- Computervision Japan
- Data I/O Japan
- Design Automation
- Fuji Xerox
- Fujitsu
- Graphtec
- Hakuto
- Hitachi
- Hitachi Zosen
- Hitachi Seiko
- IBM Japan
- Info. Services Int'l Dentsu
- Kanematsu Semiconductor
- Marubeni Hytech
- Mentor Graphics Japan
- Mitsubishi Electric
- Mitsui Engineering
- Mutoh Industries

- NEC
- Nippon Univac Kaisha
- Nissec Schlumberger
- Otsukashokai
- Prime Computer Japan
- Racal-Redac Japan
- Rikei
- Seiko I&E
- Sharp System Products
- Silvar-Lisco Japan
- Technodia
- Tokyo Keiki
- Toshiba
- Toyo Information Systems
- Uchida Yoko
- Univac Information Systems
- Ustation
- Wacom
- Yamashita Electric Design
- Yokogawa Electric
- Yokogawa Hewlett-Packard
- Zuken

European-Based Companies

Dataquest collects data from our London office on the following European-based companies. Their market shares are called out individually only if their total end-user CAD/CAM revenue is $15 million or more:

- Cad Centre
- CADlab
- Calay
- CISI
- Dassault
- EIE
- Exapt
- Ferranti
- Marconi
- Matra Datavision
- Norsk
- Olivetti
- Pafec
- Racal-Redac
- Robo Systems
- Secmai
- Siemens
- Superdraft
- Syscan

HOW TO USE THE SERVICE

Due to the vast amount and dynamic nature of the information that is disseminated, the Dataquest CAD/CAM Industry Service offers four means of access to our research:

- Research notebooks
- Newsletters
- Inquiry privilege
- Annual conference

Research Notebooks

The six CCIS research notebooks contain the nucleus of the CAD/CAM Industry Service research.

Core Notebooks

The three core notebooks are available to all CCIS clients and cover the entire CAD/CAM industry. These notebooks include the following:

- *Industry Overview*—An overview of the entire CAD/CAM industry, with a summary of the forecasts and trends on each of the tiers and segments illustrated in Figure 2
- *Newsletters*—An archive for all CCIS newsletters, with tabs for specific applications
- *Company Profiles*—Company and product information on the top twenty United States-based CAD/CAM vendors

Application Modules

The three application modules are available to CCIS clients that need in-depth information specific to an application. They include:

- *Mechanical CAD/CAM Applications*—Trends and analyses of mechanical applications, including mechanical computer-aided engineering, drafting, design, finite element modeling and analysis, data base management systems, and numeric control
- *Electronic Design Automation Applications*—Trends and analyses of electronic applications, including electronic computer-aided engineering, IC layout, PCB layout, compilation, and test

- *Facilities Design and Mapping Applications*—Trends and analyses of the facilities design and mapping application segments, including architectural, facilities management, process design, mapping, and geographic information systems

Newsletters

CCIS Research Newsletters contain information that is either industry event-oriented (e.g., major product announcements) or based on a Dataquest primary research effort (e.g., end-user surveys). The Dataquest CAD/CAM Industry Service typically publishes two to five newsletters per month. These go into the *Newsletters* notebook and are classified as either general CAD/CAM or mechanical, electronic design automation, or facilities design and mapping applications.

Inquiry Privilege

The inquiry service allows clients to have direct access to any of the CCIS research staff for up-to-the-minute information and analyses via telephone, telex, facsimile, or visits. This also allows clients to obtain information on a specific question or topic not found in the printed publications. To support this direct-line access, Dataquest has a highly professional research staff with an in-depth background in the CAD/CAM industry. We maintain contact with a large company base through sophisticated sampling and interviewing techniques. To contact the staff, please write, call, telex, FAX, or visit the following address:

Dataquest Incorporated
1290 Ridder Park Drive
San Jose, California 95131
Telephone: (408) 971-9000 Telex: 171973
FAX: (408) 971-9003

Also available to CCIS clients through the inquiry privilege is the use of Dataquest's extensive CAD/CAM and corporate libraries. Library visits may be scheduled by calling the CAD/CAM Industry Service directly.

Annual Conference

The annual CCIS conference is a two-day, in-depth conference held in the calendar second quarter at a resort location. The purpose of the conference is to provide a forum for the Dataquest research staff and other industry experts to share their thoughts and ideas on the CAD/CAM industry. One of the key elements of the conference is the presentation of Dataquest's current market numbers and market shares along with our projections for the next five years. All of the presentations are organized in a large loose-leaf binder and distributed at the conference.

Dataquest's CAD/CAM Industry Service clients are entitled to one free reservation at the conference. Additional employees from client companies can attend at reduced rates. Due to limited space, all clients are encouraged to register early to reserve the free seat to which they are entitled.

FORECASTING METHODOLOGY

Dataquest's CAD/CAM Industry Service market estimates and forecasts are derived using one or more of the following techniques:

- "Bottom up" or component aggregation. This method involves adding all relevant vendor contributions to arrive at total market estimates for all historical data.

- Segment forecasting. This method involves creating individual forecasts for each application segment, including regional and platform forecasts for that application. In this way, each application segment incorporates its own set of unique assumptions.

- Demand-based analysis. This method involves tracking and forecasting market growth based on the present and anticipated demand of current and future users. This requires the development of a total available market (TAM) model and a satisfied available market figure to accurately assess the levels of penetration.

- Capacity-based analysis. This method involves identifying future shipment volume constraints. These constraints, or "ceilings," can be the result of component availability, manufacturing capacity, or distribution capacity. In any case, a constraint in one of these areas is capable of keeping actual shipments below the demand level.

Dataquest's revenue and shipment estimates are based on the following sources:

- Information supplied by company management or gathered from publicly available published sources

- Information supplied by other Dataquest industry services relating to components/subsystems of CAD/CAM systems

- Information provided by OEMs or resellers of the manufacturers' products

- Large-scale end-user surveys

- Senior staff estimates based on reliable historical data

The CAD/CAM Industry Service data are based on revenue and unit data of systems sold to end users. Great care is taken with our actual unit and revenue numbers to avoid double counting.

Despite the care taken in analyzing the available data and attempting to categorize it in a meaningful way, we offer a few caveats regarding interpretation of the data:

- Certain assumptions, definitions, or conventions implicit in our forecasts may differ from those of others. Please refer to our *Industry Overview* and application notebooks glossary for definition of forecasting terms and analysis and interpretation of the data in order to understand our definitions and assumptions.

- Our shipment estimates of systems and workstations include only those delivered to paying customers, not the total that is manufactured (the backlog).

- Revenue and average selling price estimates are based on transaction prices, not list prices.

- All data elements have been adjusted to reflect the forecast period, which is the calendar year.

- Many manufacturers do not release their actual unit sales, application distribution, geographic distribution, or platform distribution. In order to provide our clients with the most accurate forecasts, we have given careful consideration to estimating these companies' data.

- Prior to 1983, Dataquest did not segment revenue geographically other than into U.S. and non-U.S. markets. To accommodate the expanded geographic segmentation, we have added all non-U.S. data into the ROW segment for 1981 and 1982.

- Prior to 1983, Dataquest did not differentiate products based on hardware type. To accommodate our expanded product type segmentation, we have grouped all product types prior to 1983 into the host-dependent category. Although not all systems shipped prior to 1983 were of the host-dependent variety, the vast majority were.

1 Industry

1.1 Scope and Definitions

1.1.1 DEFINING THE CAD/CAM INDUSTRY

The phenomenal growth of the CAD/CAM industry, in terms of annual revenues, technology, customer base, potential market, and the number and variety of suppliers of CAD/CAM products, has brought with it the challenge of analyzing the CAD/CAM market. A decade ago Computer-Aided-Design and Computer-Aided Manufacturing were almost exclusively the purview of the aerospace and automotive industries and of government supported researchers. Borrowing technology and applications approaches from a wide variety of disciplines, less than a dozen companies were marketing products that today would fall within the CAD/CAM industry.

Although the industry can still be said to be in its infancy, the landscape has changed radically. DATAQUEST estimates that over 20,000 workstations are currently in use worldwide for CAD/CAM applications. Manufactueres have sold CAD/CAM equipment to companies to aid in the design and manufacture of thousands of different products. Major technological advancements in both hardware and software have made CAD/CAM affordable and usable for end users at all levels. Finally, companies actively pursuing this expanded CAD/CAM market can now be counted in the hundreds and they are offering an increasing variety of innovative and sophisticated products.

The DATAQUEST CAD/CAM Industry Service is intended to serve those interested in analyzing the CAD/CAM industry and marketplace. Because of the variety of product offerings, approaches, and companies that have recently emerged in the industry, we recognize that there are many alternatives for defining the scope of the service. This situation is illustrated by the recent burgeoning of acronyms to describe the automation of design and manufacturing. CAD and CAM have been joined by CIM (Computer-Integrated-Manufacturing), CAT (Computer-Assisted-Testing), CAE (Computer-Assisted-Engineering) and others.

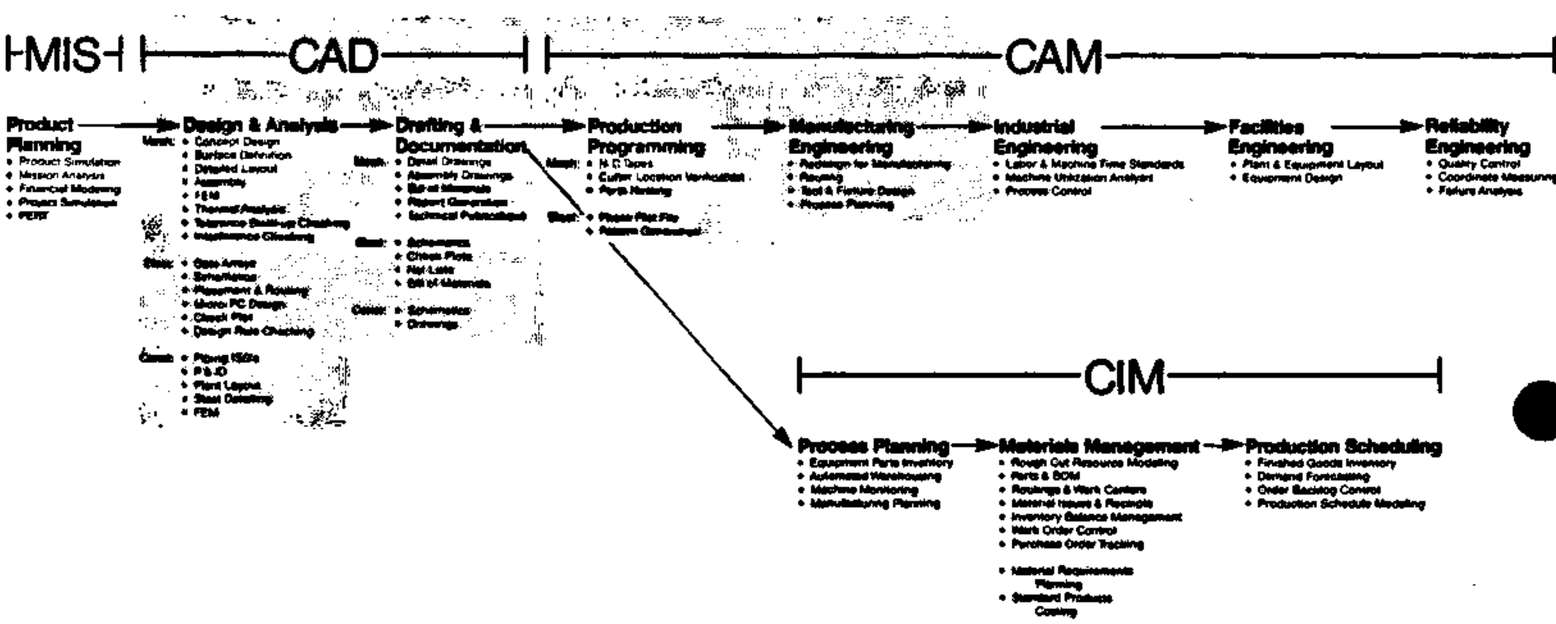
Figure 1.1.1-1 illustrates the various areas of design and manufacturing automation. In the broadest sense, automated design and manufacturing encompasses all of the subject areas represented in the figure. DATAQUEST's CAD/CAM Information Service concerns itself directly with the industries that manufacture, market, and service those computer-based products shown within the shaded area of Figure 1.1.1-1. As the market for CAD/CAM systems has evolved, three distinct CAD/CAM industry sectors (by product type) have also evolved:

- Turnkey Interactive Graphics - Companies that sell stand-alone systems (usually minicomputer-based) to perform CAD/CAM tasks
- Computer Companies - Companies selling computers as their primary business. Many of these companies have either developed hardware and software to be used for CAD/CAM applications, or will integrate such hardware and software from outside sources with their own computers

1.1 Scope and Definitions

Figure 1.1.1-1

AUTOMATED DESIGN AND MANUFACTURING



Source: DATAQUEST, Inc.

- Software - Companies selling software packages for graphics creation, design and engineering analysis, parts programming, and other CAD/CAM related tasks

In addition to companies selling CAD/CAM systems, four ancillary industries have emerged to provide for CAD/CAM users' needs:

- Hardware - Companies selling hardware components that can be integrated with other hardware components and software to perform CAD/CAM tasks
- Service Bureaus - Companies that perform CAD/CAM tasks for clients
- Time Sharing - Companies that offer computing capabilities to clients to be used in conjunction with their own hardware and software, or with hardware and software from outside sources
- Consulting Companies - Companies that assist clients with CAD/CAM related services such as system integration software development and training

Table 1.1.1-1 lists the major companies in the CAD/CAM industry by the type of product they supply.

The DATAQUEST CAD/CAM Industry Service will track the CAD/CAM activities of all of these companies with sections devoted to analysis of the market by product type, application area and hardware type.

1.1.2 DEFINING THE CAD/CAM MARKETPLACE

As suppliers of CAD/CAM equipment have expanded and improved their product offerings, CAD/CAM has found its way into more and more industries. Of the 122 major non-agricultural industries examined in the U.S. Department of Commerce 1981 U.S. Industrial Outlook, 87 have been identified by DATAQUEST as either having CAD/CAM systems in place or as having application needs that would cost-justify CAD/CAM systems.

1.1.3 SEGMENTING AND STRATIFYING THE CAD/CAM MARKETPLACE

For analysis purposes, it is useful to segment and stratify the CAD/CAM marketplace in a meaningful way. Strategic market planning for a marketplace as broad-based as the CAD/CAM marketplace is all but impossible without a means of focusing on the key segments within these industries.

1.1 Scope and Definitions

Table 1.1.1-1

MAJOR CAD/CAM COMPANIES BY PRODUCT TYPE

Company	Turnkey Interactive Systems	Soft-ware	Hard-ware	Computers	Service Bureau	Consulting	Time-sharing
A.M. Bruning	X						
Applicon	X						
Auto-trol Technology Inc.	X						
CALMA (A Subsidiary of General Electric)	X						
Calcomp (A Sanders Associates Co.)	X		X				
Camsco	X		X				
Computervision Corp.	X						
Control Data Corp.			X	X		X	
Daisy Systems	X						
Data General Corp.			X	X			
Data Technology, Inc.		X		X		X	
Dicomed			X				
Digital Equipment Corp.			X	X			
Digital Systems Corp.				X			
Evans & Sutherland	X		X				
General Automation, Inc.			X	X	X		
Genisco Computers			X				
Gerber System Technology Corp.	X						
Graphics Technology Corp.		X					
Hewlett-Packard	X		X	X			
IBM Corp.			X	X			
Information Displays Inc.	X						
Imlac (a Hazeline Co.)				X			
Intergraph Corp.	X					X	
Lockheed Corporation		X					
Manufacturing and Consulting Services		X			X	X	
McAuto (McDonnell-Douglas Corp.)	X					X	X
Megatek Corp.	X		X				
National Computer Systems Inc.		X					
Nicolet CAD Corp.	X		X				
NISA/FEM (Engineering Mechanics Research Corporation)		X					
Prime Computer				X			
Ramtek			X				
Redac Interactive Graphics Corp.	X				X		
SDRC		X			X	X	
Summagraphics	X		X				
Sperry-Univac				X			
Synercom Technology, Inc.		X				X	
Tektronix, Inc.			X				
Versatec (A Xerox Co.)			X				
Westinghouse Electric Corporation			X	X			

Source: DATAQUEST, Inc.

1.1 Scope and Definitions

Below is a conceptual scheme for analyzing the CAD/CAM marketplace based in part on the U.S. Government Standard Industry Classification (SIC) System:

- Economic Division (Example: Manufacturing or Construction) (One-digit SIC)
- Division Sectors (Example: Discrete vs. Process Manufacturing)
- Industry (Example: Automotive) (Four-digit SIC)
- Functional Groups (Example: Design vs. Manufacturing)

The SIC system was developed originally so that the massive amounts of data on U.S. industry collected by U.S. Government agencies could be compiled and organized in a useful way. SIC numbers have been adopted widely since they were first devised and are currently used by all Federal statistical agencies, most state agencies, and many private organizations. Two categories, the "Economic Division" (one-digit SIC) and "Industry" (four-digit SIC) will prove to be useful to DATAQUEST CAD/CAM Industry Service subscribers.

We have expanded on this framework, however to include two classifications of special interest to the CAD/CAM industry. These additional classifications are "Division Segments." The CAD/CAM product and marketing requirements in the discrete versus processing sectors of the manufacturing economic division are significant enough to merit this analytical distinction. This treatment also applies to the process plant, power plant, public works, commercial building, industrial building and residential housing sectors of the construction economic division or "Functional Groups."

In reporting data on the industries served by the CAD/CAM industry, the DATAQUEST CAD/CAM Industry Service will use the hierarchy of economic units described in above. This structure will enable us to present data from the level of the Economic Division all the way to the CAD/CAM equipment end user in a way that will be easy to use and interpret. For example, a relative increase in demand for systems used in manufacturing versus design in the automotive industry will be reported at the functional group level. Trends in expenditures for research and development in electronics, on the other hand, will be reported at the major industry group level. Using this classification scheme, user surveys, individual industry statistics, and government statistics on entire economic divisions can be interpreted from the perspective of the CAD/CAM industry.

The following discussion briefly outlines the characteristics of each of these categories.

1.1 Scope and Definitions

Economic Divisions

CAD/CAM products are marketed predominantly to the manufacturing and construction economic divisions. There are also some very specialized applications in the medical and scientific areas, and a significant number of systems are used for cartographic applications. DATAQUEST's estimate of the current CAD/CAM user base by economic division are presented in Table 1.1.3-1.

Table 1.1.3-1

ESTIMATED 1981 CAD/CAM SYSTEM
USER BASE BY ECONOMIC DIVISION

Division	Systems	Workstations
Manufacturing	3,400	11,500
Construction	1,300	4,000
Others	800	2,500
Total	5,200	18,000

Source: DATAQUEST, Inc.

Division Sectors

These sectors do not appear in the SIC but are very useful in analyzing the CAD/CAM marketplace. The segments that occur within the manufacturing and construction economic divisions are the following:

Manufacturing

Discrete manufacturing results in products that are fabricated from uniquely identifiable parts. These parts are then assembled into sub-assemblies and, finally, finished products such as machine tools, automobiles, and computers. Process manufacturing, on the other hand, results in products that are identifiable only in bulk. Cement and paper are examples of products that result from process manufacturing.

Discrete Manufacturing Sector - This sector represents the major market for CAD/CAM equipment used for mechanical design, electronic design, and computer-aided-manufacturing applications. DATAQUEST estimates that 40 percent of the CAD/CAM equipment sold in 1980 was in this sector. The three largest user industries for CAD/CAM—aerospace, automotive and electronics—are also in this sector. These industries are also highly engineering intensive and each has major automation requirements in the areas of design and manufacturing. Although CAD/CAM equipment has penetrated these three industries more than any other U.S. industries, DATAQUEST believes that they still have significant growth potential for the next five years. All have shown significantly high capital expenditures over the past several years and indications are that this trend will continue.

DATAQUEST believes that another important characteristic of these three industries is their level of concentration. With the possible exception of the electronics industry, all of the industries within this group are highly concentrated and populated by Fortune 500 companies. Marketing capital equipment to companies of this type often leads to marketing strategies such as national account management. In addition, in purchasing CAD/CAM equipment, these companies have tended towards a similar set of system requirements as follows:

- Data base management (to assure company-wide standards in design and manufacturing)
- Large data base storage capabilities
- Communications within an existing mainframe computer environment
- Multiterminal systems (with terminal requirements tending to exceed the existing technology for turnkey systems)
- Major requirements for applications software development
- A significant requirement for remote, communicating, stand-alone terminals in some industries and companies

These industries should continue to constitute a major portion of the market for CAD/CAM; therefore, they are also likely to be a major influence on product development trends over the next five years.

Another important characteristic of these three industries is the extensive system requirements that they exhibit. With a few exceptions, companies within these industries have major requirements for drafting, design and documentation, and analysis and manufacturing automation. These requirements have led companies to select vendors offering products with comprehensive capabilities. DATAQUEST feels that this trend will continue with the exception of the drafting area. Companies with relatively inexpensive entries in the automated drafting products areas, which are used to supplement more comprehensive and expensive systems, will probably make extensive in-roads in these industrial sectors within the next five years.

Other industries within the discrete manufacturing sector which are major markets for CAD/CAM equipment, are machine tools, apparel, fabricated metal products, and instruments. Because growth, capital expenditures and engineering intensity are relatively lower in these industries, DATAQUEST feels which as markets for CAD/CAM products they will continue to grow, but at a slower pace than the three major discrete manufacturing sectors discussed above. These industries should prove to be major markets for low-end and mid-range CAD/CAM systems, because the more comprehensive systems of the major turnkey vendors may prove to be too costly within these industry groups.

Process Manufacturing Sector - Two of the three major industries within this sector—chemicals, petroleum and coal—represent a major market for CAD/CAM systems. CAD/CAM has penetrated the chemical industry less than either the petroleum or coal industry, although it is a highly engineering-intensive industry that also ranks high in terms of capital expenditures. Historically, the petroleum industry has been a major user of CAD/CAM technology with application requirements in the areas of process plant design and mapping. Of particular interest in this industry is the fact that 66 percent of all capital expenditures take place in the Southwestern United States. Because of the major design requirements in the energy field, DATAQUEST feels that sales of CAD/CAM equipment to companies in this industry group will grow at an accelerated rate over the next five years.

The system requirements that have been established within the process manufacturing sector are:

- Central data base to facilitate drawing updating and subcontracting
- Less expensive remote workstations to fit with project-oriented procurement practices and subcontracting practices
- Specialized application packages for piping, plant layout, structural steel, schematics, and others
- Sophisticated data base management systems to facilitate data extraction tasks such as bills of material

As petroleum and chemical process plant design has been the major source of CAD/CAM sales in the process sector, this sector bears a close relationship to the Construction Economic Division. The CAD/CAM companies that have established the strongest customer base within the petrochemical industries (most notably Auto-trol and Intergraph) have also had great success within the construction industry. This finding is not surprising in that process plants built for the petro-chemical industries usually fall into the category of super projects costing billions of dollars and involving the participation of the largest construction engineering firms.

1.1 Scope and Definitions

Construction

The construction economic division of the United States—long identified as a target of the CAD/CAM industry—is, like manufacturing, diverse and complex. The construction firm ranked the 400th largest in the United States reported contracts of more than $35 million in 1980, a statistic that gives an idea of the size and diversity of the construction division.

To facilitate the analysis of this very complex CAD/CAM marketplace, DATAQUEST has divided the construction economic division into six sectors based on type of construction project. These sectors are: process plants, power plants, public works, commercial buildings, industrial buildings and residential housing. This classification scheme is useful in analyzing the construction industry for the following reasons:

Application Specialization - Architectural, engineering, and construction (AEC) companies that specialize in certain types of projects also tend to have specialized sets of application requirements. For example, those companies that specialize in process plant design and construction have a need for schematics, piping, plant layout and structural analysis. Trends evolving from these types of construction projects will have a significant impact on product development within the CAD/CAM industry.

Design-Construct Specialization by AEC Companies - Major companies specializing in the two most promising construction sectors for the CAD/CAM industry—process plants and power plants—are almost all design-construction firms with large staffs of design engineers as well as construction managers. (Examples of such firms are Brown & Root, Fluor, C.E. Loomis, and Parsons). Of the top ten design-construction firms of 1979 (with bookings for design-construct or design-only contracts of approximately $32 billion) nine are involved in process plant design. Because of the very large component of in-house design work within companies specializing in process plants and power plants, DATAQUEST feels there is a large latent demand for CAD/CAM within these two sectors.

Industry Concentration - Of the six construction sectors identified by DATAQUEST, four (commercial buildings, industrial buildings, public works, and residential housing) are highly unconcentrated (i.e., have large numbers of AEC firms participating). Two sectors (process plants and power plants) are far more concentrated because process plant and power plant construction projects are often $1 billion-plus projects that can be handled only by AEC firms with very large technical staffs.

The AEC firms that participate in the highly concentrated sectors of the construction division are analogous to the Fortune 500 manufacturing companies in the manufacturing division that have long been the target of the CAD/CAM industry. They are large, technologically-oriented companies with large technical staffs. They already have a familiarity and some experience with CAD/CAM and have the resources to justify mid-range and high-end CAD/CAM product offerings. DATAQUEST feels that the major growth of the traditional (turnkey and computer company) product offerings will take place in those AEC firms specializing in process plants and power plants, with some growth also taking place in the public works sector. Low-end turnkey systems (for 2D drafting), time sharing, and service bureau-type products will continue to show moderate to rapid growth across all of the division sectors.

Industries

Significant statistics and an analysis of selected industry groups and industries of interest to CAD/CAM professionals will appear in Section 1.7. Vital statistics on all of these industries are tracked and updated by the DATAQUEST CAD/CAM Industry Service.

Functional Groups

DATAQUEST has identified seven functional groups with CAD/CAM requirements in the Manufacturing and Construction Economic Divisions.

Design and Analysis

This is the area that has drawn the most interest to CAD/CAM. Three-dimensional modeling, automated placement and routing of electronic devices, and accurate three-dimensional modeling of complex piping runs are but a few of the approaches to design and analysis that were virtually impossible before the advent of computer-aided-design technology. Return on investment for CAD/CAM systems is probably the highest here of any functional area, because computer aid to the most highly skilled and highly paid technical people is involved. Because of a software development lag that most directly affects this area, DATAQUEST estimates that as low as 20 percent of current system time is spent in performing these functions.

Drafting and Documentation

DATAQUEST estimates that 50 to 60 percent of current system time is spent performing these functions. While CAD/CAM is a labor-saving device in the areas of drafting and documentation, the tasks performed here are somewhat trivial when compared to the design and analysis functional areas. Nonetheless, many \$300,000-\$500,000 CAD/CAM systems have been cost-justified in two to three years, on the basis of being used only for drafting and documentation. This factor is especially true in the integrated circuit design industry.

Production Programming

DATAQUEST estimates that only 10 to 20 percent of current system population time is devoted to production programming. Numerical control parts programming will be a major growth area for CAD/CAM systems in the next five years.

Manufacturing Engineering

The major application areas for CAD/CAM in this functional area are tool and fixture design and the value engineering of existing product designs. The value of a central data base and the data base management systems now being developed by the major CAD/CAM vendors should open a large potential market for CAD/CAM systems in manufacturing engineering within the next two years.

Industrial Engineering

Family of parts and group technology capabilities now being developed and expanded by CAD/CAM vendors will mean an expansion of the market for CAD/CAM systems used for industrial engineering. DATAQUEST feels that this market will initially be developed by companies with a large base of sophisticated CAD/CAM users and that these applications will gradually diffuse to other segments of the CAD/CAM customer base. Because of the growing customer base over the next five years, however, diffusion should be fairly rapid.

Facilities Engineering

In the area of plant layout, CAD/CAM vendors with large customer bases in the area of mechanical design (Applicon and Computervision in particular) have been able to develop a substantial market for facilities engineering systems. DATAQUEST estimates that system sales for facilities engineering applications will keep pace with sales growth across all functional areas.

Reliability Engineering

Because the data base design of CAD/CAM systems has thus far centered around design, analysis, and drafting and documentation functions, system usage for reliability engineering has been limited. Net lists and block lists generated for printed circuit board design have been used in reliability engineering, and development of techniques for using integrated circuit design data bases in reliability engineering is occurring. Again, with the development of more sophisticated data base management systems, DATAQUEST feels that there is a significant market for CAD/CAM systems for use in reliability engineering, although full development of this marketplace may be two to three years away.

1.2 Productivity in Design and Manufacturing

Recent alarming decreases in the level of annual productivity improvement, especially in the United States as compared to other economically advanced nations, have made productivity improvement a national priority, and CAD/CAM has been one of the outstanding success stories in our quest for higher productivity. Thus, the productivity question and the CAD/CAM answer are inextricably linked, and we feel it appropriate to give some background on the problem of productivity in general, and how CAD/CAM helps solve it in the fields of design and manufacturing.

1.2.1 MEASURES OF PRODUCTIVITY

Productivity, as we will use it in this section, is the output of real usable product per man-hour worked. Although a broader definition might relate the output to the sum of all input resources, our concern is with the provision of improved equipment, materials, and techniques to the worker, which will show up in terms of observable increases in the narrower measure (also known as "labor productivity"). (The simpler measure is the one commonly calculated and referred to in government statistics and popular literature.)

Productivity gains in the United States since World War II can only be described as mediocre. From 1948 to 1968, the United States experienced an overall average annual increase of 3.2 percent in output per hour worked. From 1968 to 1973, the rate of improvement dropped dramatically, to 1.9 percent per year. As poor as this performance was, it was far better than that of the 1973 to 1979 period, when the increase was a mere 0.7 percent per year.

Viewing the American economy on a sector-by-sector basis produces a mixed perspective. Several sectors have actually experienced negative productivity growth during the last few years. Manufacturing has achieved above-average but unspectacular growth. From a productivity growth rate that averaged 2.9 percent per year during the 1967 to 1973 period, the manufacturing sector's productivity growth rate slipped to only 1.6 percent per year during the 1973 to 1979 period. This decline is even more onerous when viewed against a backdrop of the growth rates experienced by countries regarded as the leading economic competitors of the United States: France—5 percent, Japan—4 percent, and West Germany—5 percent. It seems clear that if the United States wishes to maintain its world leadership in overall productivity—which it still holds in the absolute sense—it will have to take strong measures to reverse this alarming downtrend in productivity improvement. In the meantime, of course, no one expects countries such as France, Japan or West Germany to sit still, so the productivity issue is likely to be of continuing interest in international economics.

But, what is causing the decline in manufacturing productivity? Although much of the decline is blamed on such factors as a breakdown of the work ethic and excessive government interference, economists tend to point to two major culprits—low spending for research and development and inadequate capital investment. These factors are well documented, both in terms of their trends over the last 20 years and in terms of the position of the United States relative to that of other countries. In the United States, research and development spending has dropped from its former level of approximately 2.0 percent of real gross national product (GNP) experienced in the early 1960s to about 1.6 percent in the late 1970s.

Even more dismaying than this drop in GNP is the change in spending priorities. There has been a recent trend toward emphasizing the D in R&D, to the detriment of the basic research that is needed if longer-term productivity gains are to be forthcoming. Of the total U.S. government research spending, nearly one-half is for defense-related projects and their applicability to industry is often minor and/or long in coming. Despite a series of dramatic tax cuts the U.S. level of capital investment in plants and equipment has remained at approximately 7.5 percent of GNP, as compared to the Japanese level of 17 percent and the West German level of 9 percent. (As we note below, it appears that the application of CAD/CAM systems is reversing both trends, as these systems enable a more rapid application of the fruits of R&D efforts, and they clearly represent large capital investments.)

1.2.2 PRODUCTIVITY IN INDUSTRY

The benefits of productivity improvement to individuals, companies, and countries are significant. A healthy and growing economy can do much to improve the quality of life due to expanding employment opportunities and a variety of programs to improve the environment, the plight of the poor and aged, and the like. The profitability of individual corporations is enhanced because of the more efficient utilization of their resources and their more competitive stance in world markets. Faster GNP growth, of course, helps the United States maintain its world leadership role.

The most significant methods for improving productivity appear to be the following:

- Continued improvement in government policies - Reduced capital gains taxes, more liberal investment tax credits, and similar changes should help spur capital formation and investment in productive facilities.

- More enlightened management - The failure of current management approaches that focus on short-term profitability and demand-side economics may lead to new approaches. (Witness, for example, the recent publicity accorded to Japanese management philosophies and techniques.)

- Increased automation - It seems inevitable that an increasing fraction of the nation's output will be created by numerically controlled machine tools, robots, and the like. Concurrently, there should be:
  - A reversal of the information explosion, which is being created by the availability of ever-cheaper computers
  - The harnessing of these computers to work only on the important information, so that improvements in the manufacturing productivity process are not negated by the additional cost of computers and their associated staffs and overhead.

1.2.3 IMPACT OF CAD/CAM ON PRODUCTIVITY

The use of CAD/CAM clearly falls in the increased automation category of methods for improving manufacturing productivity. Anyone who has spent time in traditional design or manufacturing environments would agree that there has been room for improvement. Until recently, the high costs of computer hardware and the lack of systems analysis and programming for design and manufacturing applications have prevented application of these sophisticated approaches. Laborious manual drafting techniques, paper-based drawing filing and retrieval systems, and hand calculations were the rule rather than the exception in design and engineering departments. Although at present CAD/CAM makes no claims to great time savings in producing initial designs, it does produce major savings in making revisions. Data are entered only once. This factor not only produces economies in itself, but it also greatly facilitates coordination among two or more designers working on the same project because they can all work from a common database, one that is always up to date. Such boring, time-consuming, and error-prone tasks as finite element modeling, which was previously done by hand, are now delegated to a CAD/CAM system.

As a result of these improvements, the productivity of engineers, designers, and draftsmen has jumped anywhere from 5:1 to 20:1. The main benefit of the implementation of CAD/CAM systems is, therefore, the lower cost of preparing a given number of designs, or perhaps the ability to prepare a substantially larger number of designs with the same staff. An important part of this cost reduction results from reductions in the number of prototypes to be manufactured and in the number of different parts, i.e., more standardization is possible. Furthermore, the automated preparation of programs for numerically controlled machine tools yields considerable savings over earlier programming techniques, and the efficient utilization of the tools themselves leads to higher output for the same investment.

There are also indirect benefits made possible by the implementation of CAD/CAM.

- Since skilled personnel are in short supply, CAD/CAM permits expansion of design output without recruiting additional designers, often a nearly impossible task in some industries or areas of the country. As the use of CAD/CAM becomes more widespread, it is likely that the availability of such systems will become a prerequisite to hiring better personnel, because of its drudgery-saving characteristics.

- The total cycle time for design and production initiation can be shortened, and can provide an important competitive advantage. Furthermore, shortening the time also reduces the costs that can be charged to the new product. Intel Corporation, for example, has pointed out that its integrated circuit design automation has been an important factor—both in speed and cost—in staying ahead of its competitors in the highly competitive semiconductor industry.

- Intelligent use of CAD/CAM can yield better designs. Because the time-consuming and unrewarding aspects of trying alternative designs are largely eliminated, designers are free to concentrate on the more creative design aspects. The ability to visualize designs in three dimensions has contributed to better designs, as has CAD/CAM's ability to quickly retrieve designs of adjoining parts/assemblies, or of similar designs from other projects that provide a good starting point for a new design.

The direct costs involved in acquiring and operating CAD/CAM systems are very evident and quite high. The investment required for a turnkey CAD system with three or four workstations is typically $300,000. The costs of the numerically controlled machine tools are also substantially higher than their less-automated counterparts. Associated software support and maintenance charges for this complex equipment are high. During the last two years, especially, the interest cost on the money tied up in such systems has also assumed a much more significant role.

Finally, there are also indirect costs incurred when organizations get and use CAD/CAM systems. CAD systems must be placed in facilities that are more comfortable with respect to temperature and humidity than those in which engineers, designers, and draftsmen have traditionally worked. These facilities cost money above and beyond the hardware system cost. People costs associated with the shift from manual to automated methods are even greater. Usually, the design and manufacturing organizations have to be changed, resulting in temporary productivity decreases and some employee dissatisfaction. And, while CAD/CAM systems do not normally require additional staff, they require a different type of skill or at least a substantial level of training.

1.2 Productivity in Design and Manufacturing

The rapid growth and success of the CAD/CAM suppliers attest to the fact that users have weighed all of the direct and indirect benefits and costs and found that there is a net plus for CAD/CAM. However, CAD/CAM implementation usually has been accompanied by some resistance due to psychological and sociological factors such as those listed below:

- Resistance to change from a traditional set of work methods and habits to a dramatically different set
- Apparent reduction in job security and status, with accompanying fears of layoffs due to "replacement by a machine"
- Job de-enrichment, due to fragmentation of tasks and perceived reduction of possibilities for creativity
- Increased fatigue because the work pace is set by a computer

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1.3 History of CAD/CAM

1.3.1 CAD

The early history of CAD closely parallels that of the development of interactive computer graphic display terminals. CAD's early beginnings occurred in the late 1950s and early 1960s, with the invention of the light pen and some sophisticated experimental work on early laboratory-scale computers at MIT. A major milestone was the pioneering effort presented in a Ph.D. thesis at MIT written by Ivan Sutherland. This document provided an important advance in theory that led to future software developments. Efforts at commercialization were limited mainly to in-house activities at the giant automotive and aerospace companies, whose engineering and design budgets make them obvious targets for such systems because of the potential for cost savings and improved design coordination.

The mid-1960s saw substantial evolution of customized CAD systems, as all of the components became available—including interactive graphic terminals, digitizers, light pens, plotters, and the general purpose components such as computer CPUs, keyboards, and hard-copy devices. Because the electronic systems for generating lines and characters were costly, the terminals were expensive; nevertheless, 15 to 20 manufacturers of such terminals began operations. The aerospace industry continued to be the main consumer of such systems.

A key development occurred in the late-1960s that dramatically reduced the cost of terminals. Tektronix storage CRTs of larger sizes were incorporated into designs from several manufacturers, permitting terminal costs to be cut by a factor of 5 to 10.

In the early 1970s, the evolution of integrated circuits and the development of the microprocessor led to declining costs for CPUs and workstations, as well as to developments and improvements in software such as pattern generators, database managers, programs for modeling geometric elements, and finite element analysis for strength calculations. These declines in cost and physical size led to the emergence of a new class of complete packaged systems known as turnkey systems. The rapid growth of the electronics industry—with an associated demand for more-rapid and cost-effective integrated circuit and printed circuit board designs—plus high inflation rates and other factors that have spurred the growth of CAD in general, led to a high demand for these turnkey systems.

Most recently, technological improvements are leading to even lower costs and more sophisticated capabilities. The areas of applicability have broadened to include five major categories—mechanical, integrated circuits, printed circuit boards, architecture and construction, and mapping. The extremely high demand for continually more cost-effective CAD systems has led to several exciting success stories for the key participants, which, in turn, continues to attract a host of new entrants with even cheaper systems or systems aimed at specialized market niches.

1.3 History of CAD/CAM

1.3.2 CAM

During roughly the same 25 to 30 years, CAM has also evolved significantly. In the early 1950s, controllers using punched paper tape were incorporated in a variety of machine tools. However, although this development permitted high machine productivity, the creation of the punched paper tape was cumbersome and time-consuming, and the approach did not catch on to a great extent.

The important breakthrough came in the late 1950s and early 1960s, with the introduction and application of the Automatically Programmed Tool (APT) language for automatically programming the punched paper tape. APT uses a special vocabulary like that used by a machinist to describe the motion of the cutting edge in a machine tool. Statements in this language are compiled into a file of cutter locations, and a software routine called a postprocessor creates a punched paper tape. The development of APT thus permitted a substantial increase in the use of numerically-controlled machine tools.

1.3.3 CAD/CAM

During the 1970s, another important advance permitted a true linking of CAD and CAM. Software was developed that created the APT statements or the file of cutter locations directly from the computerized representation of the part geometry present in the CAD system file. Separately, elimination of punched paper tape was made possible through the development of DNC (direct numerical control) and CNC (computerized numerical control) systems. The systems replace the paper tape mechanism in the machine tool with a small computer and permit more direct or even real-time computer-to-computer control.

1.4 Industry Structure

1.4.1 TURNKEY CAD/CAM GRAPHICS SYSTEMS

The turnkey sector of the CAD/CAM industry is undergoing a period of transition. In earlier years, high-performance systems produced by the leading turnkey vendors dominated the marketplace. Of late, however, three other classes of systems have also become important. These classes are mid-range performance systems, very high performance (32-bit computers) systems, and low-performance systems. The following is a discussion of the major classes of turnkey CAD/CAM interactive graphics systems. Beginning with the traditional high performace systems ($200,000 to $450,000), followed by the newer, mid-range performance ($150,000 to $200,000), and very-high performance systems (based on 32-bit computers) and finally, a discussion of low-performance systems (less than $150,000)

High-Performance Systems

An examination of the CAD/CAM industry from its beginnings until the present reveals a marketplace dominated by a few major vendors of full-capability, high-end turnkey systems. In terms of their numbers and their approaches to CAD/CAM, these companies constitute a relatively simple industry structure as follows:

- Computervision - Became an early leader in the application area that was to enjoy the most rapid growth—mechanical design. Computervision did not so much focus on the area, however, as gravitate towards it. Today Computervision's product mix closely reflects the demands of the marketplace itself, with the exception of the integrated circuit area.

- Applicon - Started at the same time and with the same broad-based approach to the market as Computervision. The company met with less success in the mechanical design area than Computervision, however, and in 1978 began to focus its efforts on the integrated circuit design market.

- CALMA - Orginally built systems for electronics applications only. After making an entry in the mapping market in the mid-1970s, CALMA launched a major development effort in the 3-D mechanical area in 1977. Although still focused in the IC design area, CALMA's present strategy is to gain a significant market share in all application areas.

- Auto-trol - Early became a dominant force in the architectural, engineering, and construction (AEC) marketplace and focused almost exclusively in that area until 1981. Auto-trol marketing efforts have aimed towards vertical marketing to construction and petrochemical companies. A major thrust into the mechanical marketplace is now under way at Auto-trol following major marketshare losses in the AEC area. Auto-trol is apparently now attempting to broaden its product base.

- Intergraph (formerly M&S Computing) - A dominant force in the mapping marketplace since the early 1970s and currently has more than 50 percent share of the market in this area. In the late 1970s, the company expanded its vertical marketing strategy to the AEC marketplace. In the case of Intergraph, these two markets have proven highly complementary, due in part to the large petrochemical and utility company customer base that Intergraph developed during its earlier years. DATAQUEST estimates that Intergraph is the major vendor in the AEC marketplace, having taken over this role from Auto-trol in the 1980 to 1981 time period. The company is now cautiously pursuing its entrance strategy into the mechanical marketplace, and plans to become a full-service turnkey vendor.

- Gerber - Sold CAD/CAM systems through its Gerber Systems Division until Gerber Systems Technology, Incorporated, was formed in early 1981. Gerber previously emphasized systems for mechanical design and, in recent years, printed circuit board design to complement its line of hardware products used in these markets. Gerber made early inroads into the core mechanical design market—especially at Boeing—but has not succeeded in building on this customer base.

Other companies such as IDI and CALCOMP participate in this market arena as well, but in terms of volume, have not been as significant as the six companies discussed above.

DATAQUEST estimates that together these six manufacturers of turnkey CAD/CAM interactive graphics systems accounted for between 75 and 80 percent of all commercial CAD/CAM systems installed in the years from 1976 to 1980. Dating back to the early 1970s, these companies have devoted more than 9 percent of their sales revenues to research and development (R&D), primarily in the software area. With the exception of Gerber, which has remained primarily in the mechanical design area, all of these companies offer high-capability products for use across a broad range of application areas. DATAQUEST feels that this lead in R&D (especially software development) is significant in regard to future competition. While other companies may, in the future, choose to take this turnkey approach to marketing CAD/CAM systems, they will almost certainly need to acquire existing software and make a considerable investment in maintaining and developing it.

Within the turnkey sector of the CAD/CAM industry the development of two new classes of systems in the past two years has added to the complexity of the industry. Mid-range systems (selling for less than $200 thousand) and 32-bit minicomputer-based systems (which in some cases may cost in excess of $1 million) have expanded the market for turnkey companies on both sides of the existing client base.

1.4 Industry Structure

Mid-Range Performance Systems

In the first half of 1981, Auto-trol, Computervision, and Intergraph announced mid-range systems. CALMA will probably announce a similar entry by early 1982. These systems are lower in price (less than $200,000) than these companies' standard product offerings, yet are based on their high-performance software. The price/performance trade-off for these systems is found in the hardware constraints: they typically will support only two workstations and have limited data processing and storage capabilities. Current product offerings in this class are not upgradable to high-performance levels although they are data-compatible with high-performance systems. Mid-range systems seem to have been designed as an entry level offering for users who cannot cost-justify a $300,000 to $500,000 high-performance system.

DATAQUEST forecasts that mid-range systems will account for 15 percent of all turnkey system revenues by 1986. This class of product should prove to be a significant factor in the industry over the next five years, especially in the AEC and manufacturing areas.

Very High-Performance Systems

Auto-trol and Applicon have already announced products based on 32-bit processors, and Computervision, CALMA, and Intergraph are expected to follow their lead within a short time. These systems are aimed at enriching the high-performance end of the market by increasing throughput, increasing system capacity (in terms of numbers of workstations), and adding data analysis and data base management capabilities. The turnkey vendors have identified the current user of CAD/CAM as the target market for these systems, because these users have the broadest system requirements. DATAQUEST forecasts that very high-performance systems will account for 20 percent of all turnkey system revenues by 1986. We feel that three companies—Applicon, Auto-trol, and Intergraph—will base their product development strategies on the expanded data base management capabilities offered by the 32-bit processor.

Low-Performance Systems

Some of the low-performance systems have been in existance for a number of years but, until very recently, they constituted a minute share of the market. Systems in this class generally sell for less than $100,000 and lack the capabilities of the high-performance systems in the areas of three-dimensional modeling, design analysis, user programming language, and specialized application software. DATAQUEST forecasts that the market for products of this class will grow from less than 5 percent of the total turnkey market to approximately 15 percent by 1986. We believe that growth in this area will be due not only to end user acceptance of CAD/CAM as a whole, but also to the existing and entering vendors in this market area that will offer improved products in the future that will increase throughput, have enhanced human engineering features, and provide specialized applications packages. In our opinion, these improvements will increase product acceptance in this area at a rapid rate over the next five years.

1.4.2 SOFTWARE

Software packages developed by government, universities, automotive, aerospace, and electronics companies were instrumental in the development of the CAD/CAM market. From this environment the software sector of the CAD/CAM industry evolved, which DATAQUEST estimates currently to be at four percent of the total market.

Generally, the software sector of this market has been marked by the following characteristics:

- A limited number of major vendors - Commercial software packages have been available since the mid-70s but only a few companies have achieved an installed base of 50 or more systems. DATAQUEST estimates that the following three companies are responsible for more than 75 percent of the installed base of the software sector of the CAD/CAM market.

    - Scientific Calculations Incorporated - Scientific Calculations software packages are used for printed circuit board design, routing, and placement. The company has evolved the strategy of marketing its software as a stand-alone product, or with hardware integrated for the customer by Scientific Calculations. The company's revenues accounted for 13 percent of the entire PC design CAD/CAM market in 1980. This market share within an application area is significantly larger than any other software company and ranks Scientific Calculations as the third largest supplier of printed circuit board design CAD/CAM products. In addition to providing hardware integration, Scientific Calculations also operates service bureaus for PC design.

    - Manufacturing and Consulting Services (MCS) - MCS software, which was sold directly to end users, accounted for over 150 installations at the end of 1981. The company sells a software package for 3-D mechanical design. In addition to sales to end users, the company has a number of licensing agreements with turnkey and computer companies that sell MCS's software as a part of their systems. MCS has pursued a marketing strategy for its software package that includes system integration, consulting, and service bureau work.

- Lockheed Corporation - In 1968, Lockheed developed a software package called CADAM for internal use, and, in 1976, the company began to market the product commercially. CADAM is a design and drafting package used primarily for mechanical applications. By the end of 1980 over 60 installations were using CADAM software marketed directly by Lockheed. In addition to selling its package directly to end users, Lockheed strategy includes a marketing agreement with IBM. Lockheed licenses its CADAM software to IBM, then IBM markets it along with its computers and graphics terminals to IBM customers.

- Application-Specific Product Development - Software vendors have focused on specific application areas, particularly mechanical design and printed circuit board design. To date, no company has developed product offerings across as broad a number of applications as has occurred with the turnkey companies.

- Assistance in Hardware Integration - Most software vendors have found it necessary to provide their customers with assistance in integrating hardware components with their software. Hardware integration and service has proven to be a significant barrier to marketing software products, despite their low cost compared to turnkey systems. As a result, software companies have found that they have had to become involved in hardware integration. Scientific Calculations has gone the farthest in this area by actively selling hardware to its customers. Revenue from hardware sales constitutes a significant portion of Scientific Calculations' business.

- Machine Independence - In order to appeal to the broadest possible market, most software vendors offer packages that are machine independent. The notable exception here is Lockheed's CADAM, which runs only on IBM or IBM-compatible machines.

1.4.3 COMPUTER COMPANIES

Companies producing computers as their main line of business (either mainframes or minis) have recognized the potential of the CAD/CAM market and have sold their customers CAD/CAM-related hardware and software components. Most of these companies have segmented the market for their computers into business, technical, scientific, and other applications, and have put together CAD/CAM packages to appeal to potential end users of their computers who have significant engineering application requirements. Several of these companies, e.g., Hewlett-Packard and Prime, have impressively large customer bases for technical applications, and the large size of the computer customer base of IBM is, of course, well known.

1.4 Industry Structure

Because of certain competitive advantages these computer companies have within the engineering community, DATAQUEST expects that they will make major marketing efforts in the CAD/CAM area in the next five years.

Marketing strategies among computer companies have been diverse over the past few years. The major participant in this market sector, IBM, acquired non-exclusive marketing rights in 1977 to the CADAM software package developed by Lockheed. IBM licenses CADAM software to end users to be used on an IBM mainframe computer (minimum configuration - 370/125 or 4331) supporting IBM 3250 graphics terminals. Along with some other software packages, IBM thus directly markets a CAD/CAM system to its custsomers. IBM has emphasized the large terminal capacity and database management capabilities of its system, and has tended to focus on installation at very large companies where these considerations are important. To date, IBM has made no attempt to market a turnkey system nor to market its own CAD/CAM software package.

Until recently, other computer companies have contented themselves with integrating existing software packages and OEM hardware with their computers in order to offer their customers a CAD/CAM system alternative. Several companies have, for example, sold MCS's AD-2000 software directly to customers with CAD/CAM requirements, as well as analysis and engineering packages such as MARC and PDMS. Large numbers of software packages have been offered by these computer companies, the strategy being to enable the customer to customize his/her system to his/her particular needs.

In May of 1981, Prime announced its "formal entry into the rapidly growing computer-aided-design market." Prime's new approach features a licensing arrangement with Cambridge Interactive Systems Limited of Cambridge, England, for the MEDUSA software package. This agreement is similar to the arrangement IBM has with Lockheed for the CADAM software.

Prime's new product entries represent a move towards a coherent CAD/CAM product offering while still offering its customers a variety of CAD/CAM alternatives. Prime is targeting sophisticated users in a large system environment where Prime feels its computers have an advantage. DATAQUEST believes that other computer manufacturers such as Data General, Digital Equipment, Hewlett-Packard, and Perkin-Elmer will adapt a similar strategy, although their approaches may differ somewhat, depending upon their position in the computer marketplace.

1.5 Impacts on/by External Factors

The potential for CAD/CAM equipment is sufficiently large so as to accommodate a sustained compound annual growth rate in excess of 40 percent over the next five years. Several external factors may have a significant impact on the industry and its growth, however.

1.5.1 ECONOMIC CONSIDERATIONS

Capital equipment sales in general are sensitive to economic trends. The CAD/CAM industry is new enough, however, that historical data is lacking on exactly how economic upturns and downturns will affect the industry.

In our opinion, 1981 will prove to be an interesting laboratory for testing the health of the CAD/CAM industry. Many economic factors have come together to suggest that there are important economic influences on the industry. Within the electronic application areas, flat growth rates in the semiconductor industry seem to be reflected in flat bookings for IC design systems. Prior to 1981, the relationship between backlogs and bookings in the semiconductor industry and the purchase of CAD equipment was uncertain. Some felt that the rate of technological advancement in CAD equipment was so great, and the design cycle of custom IC's was so independent of manufacturing and sales cycles, that a slowdown in semiconductor bookings would have little or no impact on CAD sales.

A softening of orders for IC design systems in the first half of 1981 seems to indicate, however, that this is not the case. Economic impacts on the semiconductor industry seem to have a direct impact on system sales in the semiconductor industry, at least according to the results of early 1981 system sales.

The interest rate sensitivity of the CAD/CAM industry seems to have been demonstrated in 1981 as well. With the prime interest rate at record highs in early 1981, it appears that sales cycles have been extended in some cases, while in other cases, buying decisions have been postponed in anticipation of a decline in interest rates. It also appears that business cycles in Western Europe have a different impact on CAD/CAM sales than does the domestic business cycle. CAD/CAM vendors with large West European operations reported brisk sales there while U.S. sales activity was considerably slower in early 1981.

1.5.2 TECHNOLOGICAL CONSIDERATIONS

While CAD/CAM vendors have been very successful in adapting existing hardware technologies to their customers' needs, little in the way of innovation in hardware technology has occurred in the CAD/CAM industry. One turnkey vendor,

1.5 Impacts on/by External Factors

Computervision, has dedicated itself to a policy of vertical integration and manufactures most of its own hardware. Other turnkey vendors prefer to integrate system components bought from other manufacturers.

This situation has left the turnkey CAD/CAM vendors somewhat vulnerable to technological changes from outside the industry. The advent of 32-bit processors, for example, has meant that turnkey vendors have had to adapt to realities dictated by outside forces. Computer companies with CAD/CAM offerings, on the other hand, are more the masters of their own destinies in regard to computer technology development.

While it is possible that one or another CAD/CAM vendor could "misstep" as concerns hardware, this has not happened in the past. DATAQUEST feels that there is enough latitude in product development choices among the major vendors so that no one company will achieve an unsurmountable technological advantage over the others in the near future.

1.6 Industry Trends

The years from 1980 to 1981 mark a period of significant transformation for the CAD/CAM industry. More than 20 companies have emerged in the past year to offer new CAD/CAM products, and existing companies have taken bold new steps in developing and marketing their products. We feel that the next five years will be very dynamic ones for what is already a highly dynamic industry. This section presents a summary of the major industry trends we expect to track throughout the 1980s.

1.6.1 HARDWARE PRODUCT TRENDS

In general, the CAD/CAM industry has done a commendable job of adapting technology from a number of areas. Turnkey vendors were quick to adapt the minicomputer to a number of graphic design and engineering tasks in the early 1970s and created a whole new industry virtually overnight. They not only breathed new life into the Tektronix storage tube, they also absorbed and disseminated to their customers such electronic hardware miracles as pen plotters, photo plotters, electrostatic plotters, and high resolution raster monitors, not to mention even more sophisticated computers.

We believe that developments in the sophisticated computer area will be the most significant for the industry in the 1980s and several trends are currently emerging. First, there is the development of the 32-bit microprocessor. Increasing computational power will enable turnkey vendors to increase the number of terminals supported by a single system by perhaps a factor of five. In addition, data base management and distributed processing, long-time watch words in the industry, will become a practical reality in the turnkey CAD/CAM industry. Turnkey users should also be able to do more engineering analysis locally, rather than having to rely on mainframes to do these major computational jobs for them.

At the low end of the market, decreases in the cost of microcomputers will give rise to less expensive systems that will open new markets for the industry. This year, 1981, has witnessed that introduction of the mid-range system by the leading turnkey vendors, which makes CAD/CAM available for the first time to thousands of mid-sized firms.

Finally, computer companies, both mini- and mainframe manufacturers, are becoming direct participants in the CAD/CAM market. DATAQUEST believes these companies will make major contributions to the adoption of the computer for design and manufacturing applications. These companies have developed very large customer bases and were instrumental in introducing computers into the engineering environment over the past 10 to 15 years. We forecast that they will make a similar contribution to the CAD/CAM industry during the 1980s.

1.6 Industry Trends

As concerns other hardware developments, it is obvious that the "raster revolution" is in full swing in the CAD/CAM industry. High-revolution raster devices are rapidly replacing storage tubes because of the numerous advantages they offer in terms of throughput and human engineering.

The introduction of color was a major development in the CAD/CAM industry. Color has been rapidly accepted in the electronics design marketplace and has gained surprising popularity by mechanical design and AEC users as well. We estimate that color monitors and color output devices will be major growth areas throughout the 1980s.

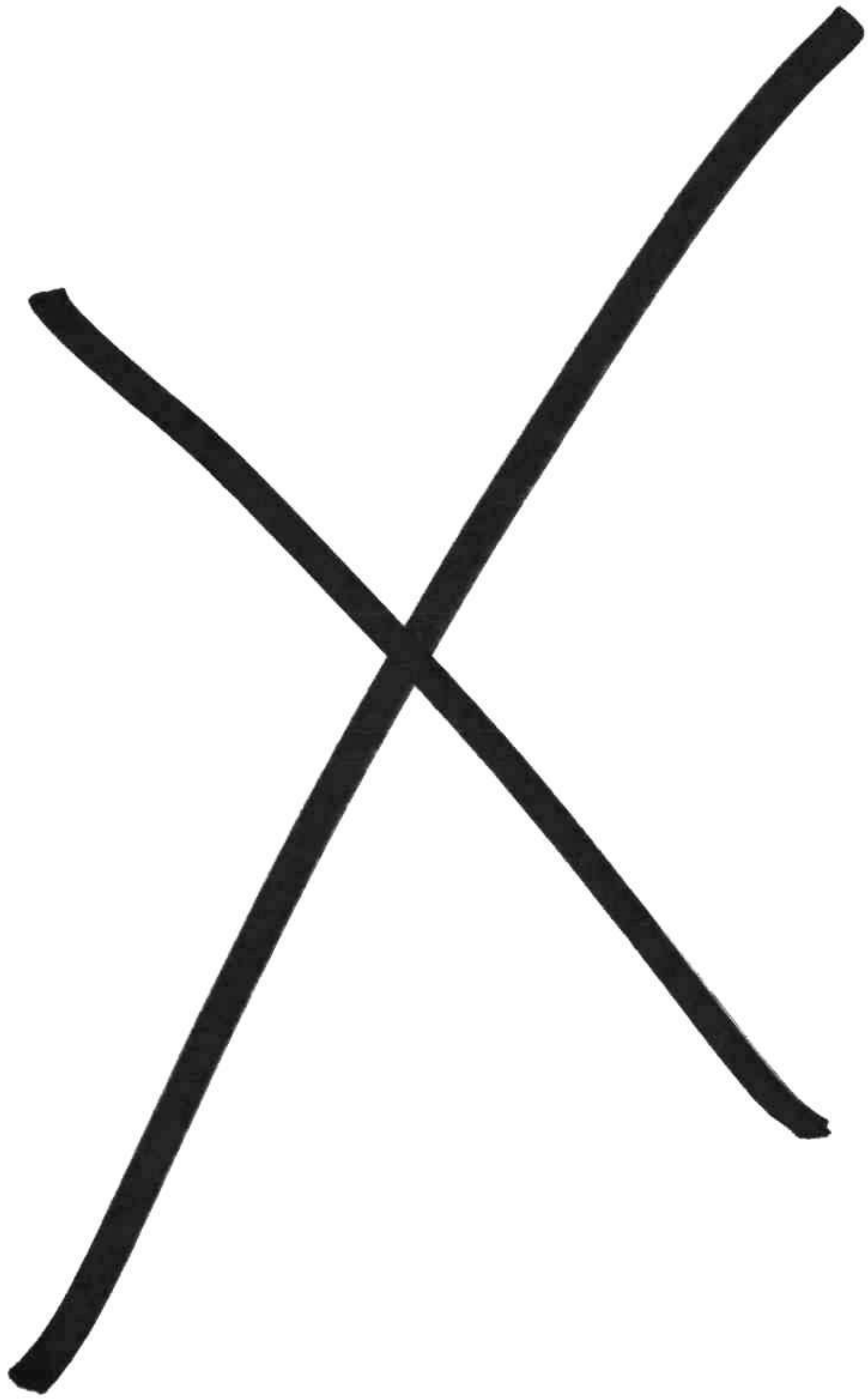
1.6.2 SOFTWARE PRODUCT TRENDS

DATAQUEST foresees an explosion in applications software development in the 1980s. In the earlier years, software development efforts were aimed at increasing basic product capabilities in such areas as geometry construction, design analysis, and automated parts programming. Often, the development of applications-specific software was left to the end user during this early period. With the expansion of the CAD/CAM market, however, a number of less sophisticated users with specific application requirements have surfaced. We feel that CAD/CAM vendors will have to respond to these specific application needs if the market is to continue to expand as we believe it will. Users will require well-developed applications packages and on-going customer support from vendors if CAD/CAM systems are to fulfill their promise of increased productivity.

In terms of basic system capabilities, much will occur in the 1980s to expand the capabilities of systems in the 32-bit environment. We feel that vendors will work closely with major customers to develop data base management capabilities. Major users of CAD/CAM equipment have expressed this need for a long time and technological advances in computing should now enable both users and vendors to proceed with development in this area.

1.6.3 MARKETING TRENDS

As the CAD/CAM market moves toward a $4 billion-plus market by 1986, major changes will take place in the marketing of CAD/CAM products. DATAQUEST foresees growth in the low- and mid-range product price spectrum as being faster than for the industry as a whole. To accommodate this growth, innovative marketing techniques will be required, as little is known about this marketplace at present. New entrants into these areas must target their markets accurately and develop successful strategies. Existing vendors selling mid- and low-range products must adapt their marketing and sales organizations to meet the realities of a new marketplace. In addition, the traditional CAD/CAM marketplace will maintain its high level of competitiveness, with turnkey companies, software companies, and computer companies all attempting to expand their market shares in a very dynamic marketplace. We feel that more innovative marketing will take place in the CAD/CAM industry in the next five years than has occurred in the entire history of CAD/CAM to date.



2.1 Market by Product Type

DATAQUEST has divided the CAD/CAM industry into three sectors. The following discussion presents an analysis of each of these sectors for the period from 1977 through 1987.

2.1.1 TURNKEY COMPANIES

Turnkey companies have constituted the largest and fastest growing section of the CAD/CAM market since the mid-1970s. We attribute the success of these systems to the use of minicomputers for interactive CAD/CAM applications, and to the turnkey companies' development of advanced graphics software. Drawing from a variety of technologies and engineering disciplines, these vendors have successfully brought computer-based design and manufacturing products to a demanding marketplace.

Table 2.1.1-1 presents our estimates of the worldwide turnkey CAD/CAM market. DATAQUEST estimates that the market for turnkey systems will exceed $5 billion in 1987, and that more than 65 percent of these revenues will come from five major companies, all of which have participated in this marketplace since the early 1970s. While many new entrants are expected, especially in the low-end product market, and although the low-end sector should grow more rapidly than the market as a whole in the next five years, the traditional turnkey leaders in this marketplace should continue to be important. Although DATAQUEST does not believe that any new companies will join this inner-circle of the turnkey CAD/CAM industry, we are certain that several computer companies will become important vendors of CAD/CAM solutions. They may even rival traditional turnkey vendors in terms of total revenues.

Despite our belief that turnkey revenues will increase from less than $1 billion to more than $5 billion during the last half of the 1977 to 1987 time period, the compound annual growth rate (CAGR) should decline from 61 percent in the first half of the period, to 41 percent CAGR in the second half. This decrease will be due to a lack of marketing and manufacturing capacity on the part of the major turnkey vendors as well as to increased competition from computer companies. DATAQUEST estimates that saturation of the potential CAD/CAM market will increase during this period from less than 1 percent to approximately 30 percent.

We believe that system retirements and new generation products will have a positive impact on the market for turnkey CAD/CAM systems. DATAQUEST estimates that there will be a strong market for turnkey systems for the remainder of the decade, and that these systems will constitute a majority of the systems installed at that time.

Table 2.1.1-1

ESTIMATED WORLDWIDE TURNKEY CAD/CAM MARKET
1977-1987

Shipments	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	CAGR 1977-1982	CAGR 1982-1987
Systems Shipped	381	571	861	1,255	1,668	2,351	3,639	5,568	8,691	14,114	23,081	44%	58%
New Workstations Shipped	1,099	1,684	2,810	4,185	5,731	7,658	11,096	17,938	30,398	46,090	69,388	44%	57%
A-O Workstations Shipped	97	141	226	343	429	646	1,111	1,944	3,137	5,122	7,966	46%	65%
Workstations Shipped	1,196	1,825	3,036	4,528	6,160	8,304	12,207	19,882	33,535	51,212	77,354	48%	58%
Installed Base													
System Retirements	49	71	95	130	184	263	366	531	781	1,179	1,826	39%	47%
Year-End System Pop.	1,343	1,846	26,12	3,737	5,221	7,309	10,582	15,619	23,529	36,464	57,656	41%	51%
Year-End Workstation Pop.	3,664	5,309	8,079	12,203	17,753	25,173	36,119	54,199	85,024	131,984	202,741	48%	52%
Revenues (Millions of Dollars)													
Annual System Revenue	$ 75	$ 127	$ 225	$ 387	$ 575	$ 763	$1,090	$1,532	$2,138	$ 2,993	$ 4,234	61%	41%
Annual Service Revenue	13	23	40	67	97	136	196	277	387	544	754	60%	41%
Annual A-O/Upgrade Revenue	8	13	23	42	62	95	140	211	293	409	548	67%	42%
Total Annual Revenue*	$ 96	$ 163	$ 288	$ 496	$ 734	$ 994	$1,426	$2,021	$2,819	$ 3,947	$ 5,536	61%	41%
Increase over Prior Year	39%	71%	77%	72%	48%	36%	43%	42%	39%	40%	40%	(5%)	1%

*Slight variations in totals reflect rounding.

Source: DATAQUEST

2.1 Market by Product Type

DATAQUEST forecasts a change from increasing average system costs, which rose 14 percent annually in the 1977 through 1981 period. For the 1982 to 1987 period we forecast a 6 percent annual decrease in costs. This decline will be due partly to the major vendors' introduction of mid-range systems (costing between $100,000 and $200,000), partly to increases in the sales of low-end systems (costing less than $100,000), and partly to an anticipated rapid decline in the cost of hardware. Upward pressure on the average system price will come from software costs, which are expected to increase at a rate of 25 percent per year over the entire 10-year period, and from the introduction of 32-bit computers that will support more stations than can be supported by 16-bit computers. The net result will be price declines because hardware cost reductions will be greater than software cost increases.

DATAQUEST estimates of the distribution of revenue from the sale of various types of systems by 1987 are shown in Table 2.1.1-2.

Table 2.1.1-2

ESTIMATED TURNKEY SYSTEMS BY TYPE OF CPU
1987

System	Percent of Total 1982 Sales	Percent of Total 1987 Sales
32-bit Very High-End Systems	9.2%	17.0%
32-bit High-End Systems	26.6	50.0
32-bit Mid-Range Systems	7.4	11.0
16-bit High-End Systems	42.0	0
16-bit Mid-Range Systems	11.7	0
16- and 32-bit Microprocessor Low-End Systems	3.1	22.0
Total	100.0%	100.0%

Source: DATAQUEST

2.1 Market by Product Type

DATAQUEST estimates that the emergence of very high-end 32-bit systems and mid-range 32-bit systems will have an important impact on the structure of the turnkey and overall CAD/CAM marketplace. High-end systems based on 32-bit computers will not only allow for increased throughput and workstation capacity, it will also mean significant advances in data base management and analysis capabilities. On the other hand, 32-bit mid-range systems, in addition to their attractive prices, also offer significant advantages in terms of remote graphics processing capabilities, and we believe that they will replace today's 16-bit mid-range systems. In the area of mechanical design, the 32-bit high-end approach seems to lend itself more advantageously to pure design or analysis applications, while the mid-range systems are more applicable to manufacturing-related tasks (i.e., parts programming, manufacturing engineering, and reliability engineering). Therefore, DATAQUEST believes that those companies that are positioned with a broad line of 32-bit systems (Applicon, Intergraph, and MCAUTO) may stress both elements of their systems in future marketing strategies, whereas companies with only mid-range or high-end product lines will be limited in the end-user markets they can address.

The 1982 emergence of low-end systems that cost less than $100,000 and are based on microprocessor systems (such as those by Apollo, Metheus, or CADLINC), will also have a major impact on the turnkey environment. These systems cannot address all the engineering needs of a company (i.e., CAD, Structural Analysis, and EDP), but they can offer a very cost-effective solution in the CAD/CAM arena. Furthermore, they provide communications facilities to more powerful CPUs that can address the other needs of an engineering or technical organization. Auto-trol and Gerber are targeting strategies for this market, and many newer firms are also offering products in this area. In 1982 companies such as AM Bruning, CADLINC, Daisy Systems, Mentor Graphics, Sigma Design, and Valid Logic produced these low-end systems. In 1983 an even larger number of companies is expected to begin shipments. DATAQUEST believes that this segment of the CAD/CAM market will constitute a significant portion of the overall market by 1987.

2.1.2 COMPUTER COMPANIES

Measuring the market for computer company CAD/CAM systems poses a problem because often the computers used in these systems are also used for other applications. DATAQUEST defines a computer company CAD/CAM system as one that includes hardware, CAD/CAM software, and graphics products that are all sold and supported by the computer company. Table 2.1.2-1 is based on estimates of revenues from software, terminals, and other peripheral hardware dedicated to CAD/CAM, and on our estimates of computer central processor revenues attributable to CAD/CAM usage.

2.1 Market by Product Type

Table 2.1.2-1

ESTIMATED COMPUTER COMPANY CAD/CAM REVENUES
1979-1987

Shipments	1979	1980	1981	1982	1983	1984	1985	1986	1987	CAGR 1982-1987
Systems Shipped	11	62	221	417	714	1,135	1,705	2,780	4,401	59%
New Workstations Shipped	22	141	647	1,533	3,564	6,680	11,696	18,964	31,011	80%
A-O Workstations Shipped	34	163	385	515	1,209	2,135	3,681	6,183	10,471	80%
Workstations Shipped	56	304	1,032	2,048	4,773	8,815	15,377	25,147	41,482	80%
Installed Base										
System Retirements			4	14	35	68	123	201	332	86%
Year-End System Pop.	11	73	290	693	1,372	2,439	4,021	6,600	10,669	72%
Year-End Workstation Pop.	56	330	1,345	3,328	7,937	16,357	30,918	54,519	93,276	93%
Revenues (Millions of Dollars)										
Annual System Revenue	$10	$ 44	$ 132	$ 257	$ 410	$ 624	$ 925	$1,362	$1,973	50%
Annual Service Revenue	4	17	42	62	101	154	229	336	486	50%
Annual A-O/Upgrade Revenue	6	24	66	121	203	307	454	664	958	50%
Total Annual Revenue*	$20	$ 85	$ 240	$ 441	$ 714	$1,085	$1,607	$2,362	$3,417	50%
Increase over Prior Year		325%	183%	83%	62%	52%	48%	47%	45%	(11%)

*Slight variations in totals reflect rounding.

Source: DATAQUEST

We estimate that more than 50 percent of the computer company revenues during the 1982 to 1987 period will be attributable to IBM, with Data General, Digital Equipment, Fujitsu, Hewlett-Packard, Perkin Elmer, Prime, and Sperry also participating in the marketplace. However, IBM should have a lower than usual share of the installed base of systems, in the range of from 40 to 45 percent, owing to its higher per system cost relative to the other suppliers. IBM has had early successes in marketing its CADAM system, which could result in an expanded marketing effort by the company and the development of new CAD/CAM products. If so, IBM could become a major force in the overall CAD/CAM marketplace in a short time, due to the size of its installed base and marketing organization compared to those of the existing turnkey vendors. Today these computer companies are concentrating their efforts on the large mechanical CAD segment; in the future it is likely that they will move into the PC and AEC segments as well.

DATAQUEST forecasts that during the 1982 to 1987 period, the computer companies' share of revenues for the entire CAD/CAM system market will grow from approximately 24 percent to 38 percent. This represents a compound annual growth rate, over the same period, of 50 percent for the computer companies as compared to 41 percent for the turnkey companies. Given the rapid growth of the market as a whole, this estimated increase in market share for the computer companies is quite impressive. We attribute this projected growth to the increasing sophistication of the end users, and to their increasing requirements for their systems. End users will require many different application packages, which will require large numbers of terminals, data base management at the corporate or divisional level, and interactive remote and local communication facilities. We believe that these user demands can be met by computer companies with their large marketing organizations and non-CAD/CAM products.

2.1.3 SOFTWARE COMPANIES

Table 2.1.3-1 presents DATAQUEST estimates of software company revenues from direct sales. We estimate that the performance of these companies will match the overall growth of the CAD/CAM industry.

While we expect new companies to enter this market, we believe that the companies that have already attained a major share of this market will continue to hold their positions. These companies maintain the same advantage in accumulated R&D investment as do the established turnkey companies in their sector of the market. Today's software market leaders include companies such as CADAM Inc.; MDSI (a division of Schlumberger); MacNeal-Schwendler Corporation; Manufacturing and Consulting Services, Inc.; Scientific Calculations, Inc.; and Silvar-Lisco. DATAQUEST expects them to continue in their preeminent positions in the future.

Table 2.1.3-1

ESTIMATED WORLDWIDE SOFTWARE COMPANY CAD/CAM
REVENUES FROM DIRECT SALES
1980-1987

	1980	1981	1982	1983	1984	1985	1986	1987
Revenues (Millions of Dollars)	$24	$49	$83	$120	$175	$253	$367	$532
Percent of Total Market	4%	5%	6%	6%	6%	6%	6%	6%

Source: DATAQUEST

Opportunities for new start-ups in the software market should lie in specialized software, rather than in generalized mechanical, electronic, AEC, or mapping packages. Within each application area, small companies can add value to existing CAD/CAM packages with very specialized, perhaps even customized, routines. As CAD/CAM systems begin to penetrate deeper into the potential market, specialized software companies should evolve to provide for users' needs.

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2.2 Market by Major Application Area

CAD/CAM systems are used in five major application areas. Table 2.2.0-1 presents summary data on revenues by application for the period 1977 to 1987. The following discussion analyzes the overall market in terms of these application areas.

In the early years, interactive graphics CAD/CAM systems were used primarily for electronics applications; by 1976, however, one in every three systems shipped was used for mechanical design. DATAQUEST estimates that by 1987, shipments of mechanical design systems will constitute 55.3 percent of the total industry revenue, and 36 percent of total systems shipped. The forecast for turnkey companies is that 1987 mechanical shipments will account for only 36 percent of their total revenues, due to their diversification into the five main CAD/CAM segments. The computer companies, on the other hand, are forecast to derive 90 percent of their business from mechanical sales in 1987, since this is the segment they have targeted for their initial product offerings.

This forecast is due in part to the structure of the latent market for CAD/CAM. Approximately 45 percent of the engineers in the United States are employed in disciplines directly related to discrete and process manufacturing, approximately 30 percent are in electrical and electronic disciplines, and an estimated 20 percent are in civil engineering.

2.2.1 MECHANICAL DESIGN

More than 25,000 U.S. companies are involved in mechanically oriented discrete or process manufacturing, each has annual revenues of more than $2 million and each could use CAD/CAM systems. Many manufacturing firms, especially in the automotive, aerospace, and industrial machinery industries, were pioneers in the use of interactive graphics for surface definition, numerically controlled parts programming, and finite-element modeling and analysis. This strong customer base has resulted in significant repeat business for Applicon, Calma, Computervision, Gerber, and, recently, IBM. Even so, the number of firms using CAD/CAM is a relatively small percentage of the total, and this will permit high growth rates for vendors in this area through 1987.

Table 2.2.1-1 presents summary data on the mechanical design market for the years 1977 through 1987. DATAQUEST estimates that revenues from mechanical design systems will exceed $2 billion in 1985 and will reach almost $5 billion in 1987. The estimated compound annual growth rate of 44 percent for the years 1982 through 1987 exceeds that of all other application areas except the smaller IC market. DATAQUEST forecasts that

2.2 Market by Major Application Area

Table 2.2.0-1

ESTIMATED CAD/CAM REVENUES BY APPLICATION
1977-1987
(Millions of Dollars)

	1977		1982		1987	
Application	Revenues	Percent of Total	Revenues	Percent of Total	Revenues	Percent of Total
Mechanical	$31	32.0%	$ 775	54.0%	$4,953	55.3%
IC	16	16.5	117	8.2	809	9.0
PC	20	20.6	225	15.7	1,515	17.0
AEC	20	20.6	216	15.0	1,209	13.5
Mapping and Others	10	10.3	102	7.1	467	5.2
Total*	$97	100.0%	$1,435	100.0%	$8,953	100.0%

*Slight variations in totals reflect rounding.

Source: DATAQUEST

2.2 Market by Major Application Area

Table 2.2.1-1

ESTIMATED WORLDWIDE
CAD/CAM SYSTEMS FOR MECHANICAL APPLICATIONS
1977-1987

Shipments (Units)	1977	1979	1981	1983	1985	1987	CAGR 1977-1982	CAGR 1982-1987
Systems	138	354	796	1,733	3,891	9,890	51%	53%
Workstations (New Systems)	364	1,074	2,735	6,840	19,970	48,090	60%	63%
Workstations (Add-ons)	32	116	508	1,477	4,344	11,732	97%	71%
Total Workstations	396	1,190	3,243	8,317	24,314	59,822	64%	65%
Installed Base (Units)								
System Retirements	19	36	76	165	362	823	43%	46%
Year-End System Population	509	1,027	2,255	4,841	10,776	25,461	45%	48%
Year-End Workstation Population	1,284	2,978	7,798	19,929	55,696	146,175	57%	61%
Revenues (Millions of Dollars)								
Annual System Revenue	$24	$ 92	$333	$ 767	$1,584	$3,225	84%	43%
Annual Service Revenue	4	18	71	159	335	683	95%	44%
Annual Add-on/Upgrade Revenue	2	14	85	238	514	1,045	131%	47%
Total Annual Revenue*	$31	$125	$489	$1,164	$2,433	$4,953	91%	44%
Increase over Prior Year	27%	117%	82%	50%	43%	42%	6%	

*Slight variations in totals reflect rounding.

Source: DATAQUEST

computer companies will account for 56 percent of 1987 revenues in the mechanical segment, supplanting the turnkey vendors as the dominant force in this market segment.

Mechanical design is the largest application area in the industry. Therefore, DATAQUEST believes that competition will be the strongest in this area. In 1980, Applicon, Computervision, and Gerber accounted for 75 percent of the mechanical design system revenues, with Computervision alone shipping 56 percent. Auto-trol, Calma, and Intergraph, companies that have traditionally focused on other vertical markets, have started shipping products for mechanical design, and IBM, Prime, and Sperry have also made the mechanical segment their main CAD/CAM target. DATAQUEST believes that by 1987 the market share leaders will be IBM and Computervision, with Calma, MCAUTO, Prime, Intergraph, and Sperry vying for the number three position.

DATAQUEST believes that new product offerings, especially mid-range systems and very-high-end, 32-bit computer-based systems, will have a major impact on the mechanical design marketplace. Vendors that have mid-range systems with price tags of less than $150,000 have indicated that one of their target markets is the medium-sized manufacturing company. Estimates of the size of this market run as high as 10,000 businesses. A major emphasis on these smaller systems is not without its risks, however. In order to maintain margins, turnkey and computer companies will have to restructure their sales forces, and sales cycles will probably have to be reduced substantially. So far, it has not been determined how successful these vendors will be in marketing these systems.

Systems based on 32-bit super-minicomputers (such as the Digital Equipment VAX 11/780, Prime 9950, IBM 4341, and Data General MV10000) offer vendors some major opportunities and some risks within the mechanical design application area. It is expected that the majority of these systems will be used for mechanical design applications within Fortune 1000 manufacturing companies. The level of demand is high, but the development requirements for these systems by such large organizations could severely tax the software engineering staffs at the vendor companies.

2.2.2 INTEGRATED CIRCUIT DESIGN

Table 2.2.2-1 presents summary data on the integrated circuit design market for the years 1977 through 1987. Micro-electronic circuit design was one of the earliest applications for CAD/CAM systems, and DATAQUEST estimates that 8 percent of the revenue in 1982 was from this area. Of the estimated 250 systems shipped in 1982, more than half were from two

2.2 Market by Major Application Area

Table 2.2.2-1

ESTIMATED WORLDWIDE
CAD/CAM SYSTEMS FOR INTEGRATED CIRCUIT APPLICATIONS
1977-1987

Shipments (Units)	1977	1979	1981	1983	1985	1987	CAGR 1977-1982	CAGR 1982-1987
Systems	57	128	175	413	1,379	4,880	33%	82%
Workstations (New Systems)	188	474	678	1,232	3,934	12,130	35%	74%
Workstations (Add-ons)	14	34	54	115	308	829	37%	67%
Total Workstations	202	508	732	1,347	4,242	12,959	35%	73%
Installed Base (Units)								
System Retirements	8	14	29	46	100	286	35%	52%
Year End System Population	221	402	720	1,297	3,284	10,315	34%	62%
Year End Workstation Population	630	1,344	2,658	4,574	10,546	29,500	42%	55%
Revenues (Millions of Dollars)								
Annual System Revenue	$12	$36	$74	$131	$274	$629	52%	47%
Annual Service Revenue	2	7	14	25	52	115	51%	47%
Annual Add-on/Upgrade Revenue	1	4	8	15	31	64	53%	46%
Total Annual Revenue*	$16	$46	$95	$171	$357	$809	52%	47%
Increase over Prior Year	41%	88%	26%	46%	42%	51%	(15%)	13%

*Slight variations in totals reflect rounding.

Source: DATAQUEST

companies, Calma and Applicon. Calma has been a major participant in this marketplace since the company began manufacturing CAD/CAM systems in the early 1970s. Applicon began to emphasize integrated circuit design in its marketing in the 1976 to 1978 time frame and has met with great success. Beginning in 1981, Computervision made a major marketing effort in the area of integrated circuit design. Beginning in 1982, a major new segment was addressed by companies such as Daisy Systems and Valid Logic--that of the low-cost IC design automation area; this will be a rapidly growing area, with many new entrants in 1983.

DATAQUEST foresees a number of trends that will bolster demand for systems in this marketplace. The first trend is the development of 32-bit computer-based systems that will increase both throughput and data base management capabilities. The second trend is the development of symbolic layout and automatic spacing systems. These systems aim at computer generation of circuit geometry resulting from symbolic layouts that are graphically input to the system by the designer. DATAQUEST estimates a compound annual growth rate of 47 percent for the integrated circuit design marketplace from 1982 through 1987. This growth will mean a system population of more than 4,800 systems with many of these systems being low-end design automation products. This EDA segment will see much higher growth, which will be in the range of 65 to 70 percent from 1982 through 1987.

DATAQUEST also foresees the development of a number of graphics-based products intended for specific design tasks (e.g., logic diagram input and analysis), or designed to provide a common data base to interrelate design tasks (such as connectivity checks and design rule checks).

The sharp decline in the annual growth rate for integrated circuit design systems in 1981 and 1982 is largely due to downturns in the semiconductor industry. There exists little historical data on the relationship among bookings, backlogs, production capacity, and the purchase of capital equipment like CAD/CAM systems in the semiconductor industry, but 1981/1982 revenue figures from CAD/CAM vendors suggest that there is a very close and directly proportional relationship.

2.2.3 PRINTED CIRCUIT DESIGN

In the past five years, system revenues for printed circuit (PC) board design have been slightly ahead of those for integrated circuit (IC) design. Until 1981 they had parallel growth rates. The parallel has not held, however, in terms of which vendors are selling these systems or, for that matter, who is buying them. DATAQUEST estimates that three companies, Applicon, Racal-Redac, and Computervision accounted for 74 percent of the turnkey PC system revenues in 1981. In 1982 these three companies continued to dominate the market segment.

Table 2.2.3-1 indicates DATAQUEST estimates of a compound annual growth rate of nearly 44 percent from 1982 to 1987. Such a high sustained level of demand for PC systems might not have been predicted a few years ago. Although no reliable data exists on the subject, it appears that the PC system market is a case of a technology creating a market where none previously existed. Perhaps as many as 25 percent of the PC systems sold in 1982 were sold into mechanical design environments. Two major suppliers of mechanical design systems (Computervision and Applicon) have effectively used their mechanical design customer bases to expand the market for printed circuit board design.

Customers use these systems to create PC boards that are used as components of mechanical rather than electronic products. As a result, it appears that CAD/CAM systems have enabled discrete and process manufacturing firms to design and manufacture PC boards for their products where previously they were subcontracted or purchased from other divisions within their own company.. With electronic circuitry playing an even larger role in mechanical products (in controls and programming mechanisms), DATAQUEST believes that the demand for PC design CAD/CAM systems within the mechanical design environment will remain strong over the next five years. This fact is not lost on the computer companies, which also have PC products to supplement their mechanical CAD offerings.

2.2.4 ARCHITECTURAL ENGINEERING AND CONSTRUCTION

DATAQUEST estimates compound annual growth of 41 percent for the architectural, engineering, and construction (AEC) application area over the 1982 through 1987 period. Contract backlogs and the technical requirements of energy-related projects within the construction industry appear to have bolstered demand for AEC systems in 1982, whereas high interest rates seem to have had a negative impact in other application areas. Despite significant increases in marketing activities in the AEC area and an increased manufacturing capacity by Applicon, Calma, Computervision, and Intergraph, DATAQUEST estimates that growth in the AEC area in the next five years will be limited more by demand than by the vendors' supply capacity. Our estimate of system shipments exceeding 5,000 in 1987 means an average of less than one system for each architectural and construction firm with annual revenues of $5 million or more. Table 2.2.4-1 presents detailed estimates of the AEC application area.

Table 2.2.3-1

ESTIMATED WORLDWIDE
CAD/CAM SYSTEMS FOR PRINTED CIRCUIT APPLICATIONS
1977-1987

Shipments (Units)	1977	1979	1981	1983	1985	1987	CAGR 1977-1982	CAGR 1982-1987
Systems	71	131	431	884	2,255	6,097	55%	60%
Workstations (New Systems)	222	455	1,253	2,510	7,298	18,578	51%	63%
Workstations (Add-ons)	19	38	105	323	1,066	3,016	55%	78%
Total Workstations	241	493	1,358	2,833	8,364	21,594	51%	65%
Installed Base (Units)								
System Retirements	12	19	32	78	187	460	32%	54%
Year End System Population	287	480	1,049	2,375	5,758	14,810	41%	56%
Year End Workstation Population	819	1,543	3,463	7,604	19,832	52,227	44%	59%
Revenues (Millions of Dollars)								
Annual System Revenue	$15	$39	$127	$536	$499	$1,096	65%	44%
Annual Service Revenue	3	7	22	100	90	205	67%	44%
Annual Add-on/Upgrade Revenue	2	4	17	103	83	213	79%	49%
Total Annual Revenue*	$20	$50	$166	$739	$672	$1,515	67%	44%
Increase over Prior Year	42%	72%	96%	47%	44%	42%	2%	3%

*Slight variations in totals reflect rounding.

Source: DATAQUEST

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Table 2.2.4-1

ESTIMATED WORLDWIDE
CAD/CAM SYSTEMS FOR AEC APPLICATIONS
1977-1987

Shipments (Units)	1977	1979	1981	1983	1985	1987	CAGR 1977-1982	CAGR 1982-1987
Systems	84	193	330	874	2,163	5,031	43%	55%
Workstations (New Systems)	223	584	1,196	2,748	7,996	16,076	53%	56%
Workstations (Add-ons)	21	53	93	275	763	2,015	48%	66%
Total Workstations	244	637	1,289	3,023	8,759	18,091	52%	57%
Installed Base (Units)								
System Retirements	7	17	38	81	181	438	49%	53%
Year End System Population	223	513	1,069	2,393	5,615	13,335	48%	53%
Year End Workstation Population	610	1,554	3,633	8,273	21,274	49,694	56%	56%
Revenues (Millions of Dollars)								
Annual System Revenue	$15	$47	$120	$246	$478	$ 909	62%	40%
Annual Service Revenue	3	9	22	47	91	171	62%	40%
Annual Add-on/Upgrade Revenue	2	5	13	33	68	129	70%	42%
Total Annual Revenue*	$20	$60	$156	$326	$637	$1,209	63%	41%
Increase over Prior Year	56%	71%	42%	50%	39%	38%	(10%)	(3%)

*Slight variations in totals reflect rounding.

Source: DATAQUEST

Although selling CAD/CAM equipment to the AEC market has meant a major investment in software development and customer education in past years, we feel that present industry awareness of CAD/CAM is such that less effort is required today. Furthermore, applications software development by several companies has made some three-dimensional applications--such as piping, plant layout, and steel detailing--much more functional for end users. We expect that product development in AEC systems will significantly expand the demand over the next five years.

In our opinion, applications software (or the lack of it) has been a major bottleneck in the expansion of the AEC marketplace because of the lack of CAD experience and computer sophistication in the AEC industry. Now, however, with the development efforts being made by a number of CAD vendors and with the introduction of more and more user-oriented software, we believe that the AEC market has the potential to grow at an even faster pace than our 41 percent forecast.

Auto-trol, Computervision, and Intergraph accounted for 77 percent of the total revenues for AEC systems in 1982. Two of these companies, Auto-trol and Intergraph, derive more than 50 percent of their revenues from AEC system sales. DATAQUEST believes that Applicon and Calma will direct serious efforts towards this market in the next five years and that numerous smaller companies will enter the market in 1983. This increased competition should lead to major product development on AEC systems, resulting in an expansion of the potential market. It is our opinion that of all the application areas discussed here, the AEC systems market has the greatest potential and its expansion directly depends upon product development by system vendors.

2.2.5 MAPPING AND OTHER

Since the early days of computer graphics, mapping has been recognized as an important application area. The ability of the computer to associate nongraphic data with geometry is a major advantage to computer-aided mapping approaches developed early in the history of computer graphics. Other specialized systems for applications, primarily in the earth sciences, are also included in this category.

Markets for mapping systems are well established within the petrochemical, utility, and construction industries, and government agencies. Table 2.2.5-1 presents summary data on the mapping market for the years 1977 through 1987. DATAQUEST estimates annual system shipments of approximately 1,500 mapping systems by 1987. During the period from 1977 through 1982, mapping never accounted for more than 10 percent of CAD/CAM system revenues, and the market for mapping systems has grown at a slower pace than the CAD/CAM market in general.

Table 2.2.5-1

ESTIMATED WORLDWIDE
CAD/CAM SYSTEMS FOR MAPPING AND OTHER APPLICATIONS
1977-1987

Shipments (Units)	1977	1979	1981	1983	1985	1987	CAGR 1977-1982	CAGR 1982-1987
Systems	31	66	157	449	708	1,521	49%	42%
Workstations (New Systems)	102	245	516	1,330	2,896	5,525	49%	47%
Workstations (Add-ons)	11	19	54	130	337	845	49%	61%
Total Workstations	113	264	570	1,460	3,233	6,370	49%	48%
Installed Base (Units)								
System Retirements	3	9	13	31	74	151	43%	48%
Year End System Population	103	201	418	1,048	2,117	4,404	43%	46%
Year End Workstation Population	321	716	1,546	3,676	8,594	18,421	48%	51%
Revenues (Millions of Dollars)								
Annual System Revenue	$ 8	$21	$53	$106	$192	$347	58%	35%
Annual Service Revenue	1	4	10	20	37	65	59%	35%
Annual Add-on/Upgrade Revenue	1	2	6	16	30	55	68%	36%
Total Annual Revenue*	$10	$28	$69	$143	$259	$467	59%	35%
Increase Over Prior Year (%)	47%	62%	63%	40%	34%	34%	(1%)	(6%)

*Slight variation in totals reflect rounding.

Source: DATAQUEST

2.2 Market by Major Application Area

However, mapping has played an important role in the marketing strategy of one turnkey vendor in particular. We believe that Intergraph will account for almost 50 percent of mapping system revenues throughout the 1977 to 1987 period. Intergraph was very successful in converting its reputation within the petrochemical, utility, and construction industries to sales within the AEC system marketplace. Intergraph has been so successful with this strategy, in fact, that DATAQUEST estimates it was the number one supplier in the mapping and AEC systems marketplace in 1982.

DATAQUEST estimates that mapping, while it does not constitute a major portion of the revenues of the entire CAD/CAM marketplace, will continue to be an important collateral to the AEC market because of the mapping requirements that exist in the petrochemical, utility, and construction industries. For this reason, mapping should continue to be a significant application area during the next five years. We estimate a compound annual growth in revenues of 35 percent for the mapping system market during the years 1982 through 1987.

2.4 Market Shares

Market share data reveal a new trend in the overall CAD/CAM industry. Computer companies have entered the market and are rapidly gaining market share. Most notably, IBM has increased its market share from 6 percent to 22 percent since 1979. On the whole, computer companies have increased their CAD/CAM revenue from $20 million in 1979 to $441 million in 1982, representing 31 percent of the total market. Table 2.4.0-1 presents approximate revenue share data for the overall CAD/CAM industry, while Tables 2.4.0-2 through 2.4.0-6 present these data by application area.

In addition, market share gains in 1983 and beyond are anticipated for the electronic design automation (EDA) vendors, who will grow at rates much higher than either the traditional turnkey or computer company vendors during the next five years. For 1982, DATAQUEST has placed such EDA vendors in the "Other Turnkey Cos." category.

Table 2.4.0-1

ESTIMATED WORLDWIDE CAD/CAM MARKET SHARE
AND TOTAL ANNUAL REVENUES
1978-1982
(Millions of Dollars)

	1978		1980		1982	
Company	Revenue	Percent	Revenue	Percent	Revenue	Percent
Applicon	$ 22	13%	$ 69	12%	$ 91	6%
Auto-trol	22	13%	51	9%	45	3%
Calma	30	18%	62	11%	142	10%
Computervision	49	30%	191	33%	326	23%
Gerber	7	4%	17	3%	22	2%
Intergraph	18	11%	53	9%	156	11%
McAuto	0	0	13	2%	43	3%
Other-Turnkey Cos.	16	10%	41	7%	169	12%
Digital	0	0	0	0	39	3%
IBM	0	0	80	14%	311	22%
Prime	0	0	5	1%	51	4%
Sperry	0	0	0	0	3	1%
Other-Computer Cos.	0	0	0	0	37	3%
Total*	$163		$581		$1,435	

*Slight variations in totals reflect rounding.

Source: DATAQUEST

2.4 Market Shares

Table 2.4.0-2

ESTIMATED WORLDWIDE MARKET SHARE
FOR MECHANICAL APPLICATIONS REVENUES
1978-1982
(Millions of Dollars)

	1978		1980		1982	
Company	Revenue	Percent	Revenue	Percent	Revenue	Percent
Applicon	$ 8	13%	$ 9	7%	$ 24	~~32%~~ 3%
Auto-trol	5	8%	12	4%	14	2%
Calma	6	10	14	5%	66	9%
Computervision	23	39%	87	32%	150	19%
Gerber	7	12%	17	6%	22	3%
Intergraph	0	0	0	0	10	1%
McAuto	0	0	13	5%	43	6%
Other-Turnkey Cos.	10	17%	22	8%	39	5%
Digital	0	0	0	0	27	4%
IBM	0	0	80	30%	302	39%
Prime	0	0	5	2	38	5%
Sperry	0	0	0	0	3	0
Other-Computer Cos.	0	0	0	0	37	5%
Total*	$58		$268		$775	

Table 2.4.0-3

ESTIMATED WORLDWIDE MARKET SHARE
FOR IC APPLICATIONS REVENUES
1978-1982
(Millions of Dollars)

	1978		1980		1982	
	Revenue	Percent	Revenue	Percent	Revenue	Percent
Applicon	$ 7	29%	$24	32%	$ 30	26%
Auto-trol	0	0	0	0	0	0
Calma	15	61%	38	50%	50	43%
Computervision	3	10%	13	17%	16	14%
Gerber	0	0	0	0	0	0
Intergraph	0	0	0	0	0	0
Other Turnkey Cos.	0	0	1	1	21	18%
Digital	0	0	0	0	0	0
IBM	0	0	0	0	0	0
Prime	0	0	0	0	0	0
Sperry	0	0	0	0	0	0
Other-Computer Cos.	0	0	0	0	0	0
Total*	$25		$76		$117	

*Slight variations in totals reflect rounding.

Source: DATAQUEST

2.4 Market Shares

Table 2.4.0-4

ESTIMATED WORLDWIDE MARKET SHARE
FOR PC APPLICATIONS REVENUES
1978-1982
(Millions of Dollars)

	1978		1980		1982	
Company	Revenue	Percent	Revenue	Percent	Revenue	Percent
Applicon	$ 5	17%	$17	20%	$ 24	11%
Auto-trol	3	9%	6	7%	1	0%
Calma	7	24%	7	8%	8	4%
Computervision	13	45%	52	62%	88	39%
Gerber	0	0	0	0	0	0
Intergraph	0	0	0	0	0	0
McAuto	0	0	0	0	0	0
Other Turnkey Cos.	2	5%	4	4%	73	32%
Digital	0	0	0	0	12	5%
IBM	0	0	0	0	6	3
Prime	0	0	0	0	13	6%
Sperry	0	0	0	0	0	0
Other-Computer Cos.	0	0	0	0	0	0
Total	$29		$85		$225	

Table 2.4.0-5

ESTIMATED WORLDWIDE MARKET SHARE
FOR AEC APPLICATIONS REVENUES
1978-1982
(Millions of Dollars)

	1978		1980		1982	
Company	Revenue	Percent	Revenue	Percent	Revenue	Percent
Applicon	$ 3	7%	$ 10	9%	$ 13	6%
Auto-trol	13	37%	29	26%	26	12%
Calma	0	0	2	2%	18	8%
Computervision	6	17%	26	24%	49	23%
Gerber	0	0	0	0	0	0
Intergraph	9	26%	30	27%	90	42%
McAuto	0	0	0	0	0	0
Other Turnkey Cos.	5	13%	14	13%	20	9%
Digital	0	0	0	0	0	0
IBM	0	0	0	0	0	0
Prime	0	0	0	0	0	0
Sperry	0	0	0	0	0	0
Other-Computer Cos.	0	0	0	0	0	0
Total*	$35		$110		$216	

*Slight variations in totals reflect rounding.

Source: DATAQUEST

2.4 Market Shares

Table 2.4.0-6

ESTIMATED WORLDWIDE MARKET SHARE
FOR MAPPING APPLICATIONS REVENUES
1978-1982
(Millions of Dollars)

	1978		1980		1982	
Company	Revenue	Percent	Revenue	Percent	Revenue	Percent
Applicon	0	0	0	0	0	0
Auto-trol	$ 2	9%	$ 5	12%	$ 4	4%
Calma	2	12%	1	1%	0	0
Computervision	5	26%	13	31%	23	22%
Gerber	0	0	0	0	0	0
Intergraph	9	53%	24	56%	55	54%
McAuto	0	0	0	0	0	0
Other Turnkey Cos.	0	0	0	0	17	17%
Digital	0	0	0	0	0	0
IBM	0	0	0	0	3	3%
Prime	0	0	0	0	0	0
Sperry	0	0	0	0	0	0
Other-Computer Cos.	0	0	0	0	0	0
Total*	$17		$43		$102	

*Slight variations in totals reflect rounding.

Source: DATAQUEST

The following analysis discusses the market position of each of the major CAD/CAM companies. The companies are presented in order of their overall market share.

2.4.1 COMPUTERVISION CORPORATION

Computervision retains its position as overall market leader, despite the strong showing by computer companies in 1982. The company's 1982 total annual revenue share of the mechanical design market stands at 19 percent, compared to 39 percent in 1979. IBM's entry into this market has clearly led to a redistribution of overall market share that has primarily affected Computervision. However, it is important to note that Computervision's share represents 41 percent of the mechanical design revenues generated by turnkey companies, retaining Computervision in its position of leadership among these companies.

It is also important to note that Computervision's mechanical design revenues represent 46 percent of the company's total 1982 CAD/CAM revenue of $326 million. This percentage has remained unchanged since 1979 and reflects Computervision's commitment to leadership in the mechanical design segment of its business.

Computervision maintained its presence in the electronic design segment through 1982, although its printed circuit board market share declined substantially. The 1982 drop to 39 percent, from 54 percent in 1979, reflects the significant gains made by other turnkey companies, primarily Redac. On the whole, Computervision's electronic design market share reflects a decrease of only one percentage point in terms of the company's total revenues; 1979 IC/PC revenues accounted for 33 percent of Computervision's business, versus 32 percent in 1982.

Computervision's position in the AEC market was strong in 1982. The company had 23 percent of the AEC market, moving to second place behind Intergraph, the established industry leader.

Despite recent shifts in market share, Computervision remains the CAD/CAM industry leader. Table 2.4.1-1 indicates that with an installed base of close to 2,200 systems, Computervision accounted for 27 percent of the total worldwide CAD/CAM system population in 1982. The company remains well ahead of IBM, the closest computer competitor (representing 5 percent of the current installed base), and Applicon and Calma (11 and 12 percent, respectively), its closest turnkey competitors. This large customer base should continue to provide Computervision with a significant competitive advantage in an industry where new contenders are proving to be worthy opponents. For 1982, Computervision was the overall CAD/CAM industry leader, and was becoming the number two mechanical CAD/CAM supplier after IBM.

2.4 Market Shares

Table 2.4.1-1

WORLDWIDE CAD/CAM MARKET SHARE
INSTALLED SYSTEMS
1982
(Units)

	1982	
Company	Systems	Percent
Applicon	851	11%
Auto-trol	496	6%
Calma	938	12%
Computervision	2,186	27%
Gerber	215	3%
Intergraph	610	8%
McAuto	159	2%
Other Turnkey Cos.	1,854	23%
Digital	87	1%
IBM	378	5%
Prime	138	2%
Sperry	4	0
Other Computer Cos.	86	1%
Total	8,002	

Source: DATAQUEST

2.4.2 IBM CORPORATION

IBM's participation in the CAD/CAM industry has grown dramatically since 1979. The company moved into second place in 1982, based on revenues of $311 million, representing systems sold primarily for mechanical applications. IBM has captured 22 percent of the overall market, and 39 percent of the mechanical market, leading to a significant redistribution of market share among turnkey companies participating in this market.

IBM markets Lockheed's CADAM software for mechanical design. At the present time, IBM only markets the monochrome IBM 3250 terminal and so lacks the color capability of its major competition. Late in 1982, IBM introduced its Fastdraw system, based on a modified Series 1 computer, and functioning as a standalone turnkey CAD system. The 2D system sells for less than $100,000 and indicates IBM intends to continue its aggressive penetration of the CAD/CAM industry.

2.4 Market Shares

DATAQUEST estimates that IBM's 1982 CAD/CAM revenues were $311 million, growing 83 percent over 1981. This growth includes $9 million generated by sales of the circuit board design system (CBDS), which moves IBM into another application area.

2.4.3 CALMA COMPANY

Calma, which ranked third among CAD/CAM vendors, with 10 percent of the 1982 market, continues to lead the integrated circuit design segment with 43 percent of the market. Along with other vendors, Calma experienced a decline in its printed circuit board design market share. However, during 1982, Calma experienced growth in the mechanical design area, holding a 9 percent market share despite IBM's impact on the overall mechanical market. In addition, the company maintained an 8 percent share of the AEC market, an area Calma has only recently actively pursued.

General Electric's acquisition of Calma is becoming more apparent. The major internal reorganization in 1982 was followed by several new product announcements, including the CIRCUITS design automation workstation, a low-cost, standalone system running Calma's major application packages, and a major effort to convert at least part of the company's product line to Digital's VAX line of computers. We believe that these developments will help ensure Calma's continued leadership in the integrated circuit area. Furthermore, in conjunction with General Electric and its other subsidiaries, these developments should enhance Calma's ability to compete strongly in the mechanical design market.

DATAQUEST estimates that Calma's 1983 revenues will be approximately $198 million, representing 9 percent of the overall market. This should make Calma the number three turnkey vendor and number four overall, despite the near-depression environment in the IC industry, Calma's major market segment.

2.4.4 APPLICON INCORPORATED

Applicon's 1982 revenues of $91 million placed the company fifth in overall market share, and fourth among turnkey vendors. Applicon has focused its efforts since 1977 on the development of its integrated circuit design business, competing closely with Calma. At the end of 1982, Applicon's IC revenues of $30 million represented 33 percent of the company's total sales and accounted for 26 percent of sales to the IC market, versus a 35 percent share in 1979.

In the printed circuit board market, Applicon finished 1982 with revenues of $24 million, reflecting an 11 percent share. The decline in market share from 20 percent in 1979 can be attributed to gains by Redac and others, which significantly eroded the PC board market shares of all major vendors.

Applicon maintained a 6 percent share of the AEC market, reflecting the company's continuing strategy of remaining competitive in all major application areas.

Schlumberger's early 1982 acquisition of Applicon was followed shortly by significant enhancements to Applicon's entire product line. The Series 4000 systems and the Video Designer have been favorably received. In addition, Schlumberger's 1981 acquisition of MDSI should greatly strengthen Applicon's CAM and mechanical design product offerings, and enable Applicon to continue to offer a broad range of state-of-the-art products across application areas. For 1983, DATAQUEST estimates that Applicon's revenues will reach approximately $113 million.

2.4.5 INTERGRAPH CORPORATION

Intergraph, the established leader in the mapping and AEC application areas, also strengthened its position as the industry leader in the AEC market segment in 1982. Intergraph's CAD/CAM revenues in 1982 totaled $156 million. Its 1982 revenues of $90 million in the AEC segment accounted for 42 percent of the total AEC market. Another $55 million accounted for 54 percent of the mapping market, and the balance was in the mechanical area, a 1 percent share.

DATAQUEST estimates indicate continued strong growth for Intergraph, with revenues of $250 million, representing approximately 12 percent of the total 1983 CAD/CAM market, a gain of 1 percent. Intergraph's 1982 efforts catapulted it to the number two position among turnkey companies. DATAQUEST expects Intergraph to continue efforts to penetrate the mechanical design market. Intergraph's line of VAX-based products, coupled with the solids modeling capability running on its recently announced array processor, should enable the company to establish itself in the mechanical market in 1983.

2.4.6 AUTO-TROL TECHNOLOGY CORPORATION

Auto-trol's 1982 revenues of $45 million represented 3 percent of the total CAD/CAM market. The company originally addressed only the AEC and mapping markets, but in 1980 it began shifting its focus to the mechanical market segment.

Auto-trol introduced the Advanced Graphics Workstation (AGW) in 1982. The AGW is an Apollo-based, standalone system priced at less than $80,000 and should enable the company to improve its competitive position in the mechanical and AEC markets.

DATAQUEST estimates Auto-trol's 1983 revenues will be $52 million, with $30 million generated in the AEC market and the balance coming from the mapping and mechanical market sectors.

2.4.7 DIGITAL EQUIPMENT CORPORATION

Digital Equipment, a prominent OEM supplier of computers for several turnkey CAD/CAM vendors, entered the CAD/CAM market in 1981 as a system supplier. Digital combined with third-party software companies to provide CAD product offerings, and captured a 3 percent market share, based on revenues of $39 million in 1982. Of this figure, $27 million represents sales of systems for mechanical applications, with the remaining $12 million resulting from sales of systems for printed circuit board design.

Digital introduced the VAX station in 1982 and currently markets third-party software. DATAQUEST believes that development of hardware such as the VAX station will be followed shortly by application software for CAD/CAM, making Digital a significant contender in the CAD/CAM industry. Digital has a large installed base of users, and the VAX line of computers is well accepted by engineers. However, the company must address critical marketing issues relating to the conflicts involved with Digital's dual role as a major OEM CAD/CAM supplier and as a system vendor.

2.4.8 MCDONNELL DOUGLAS AUTOMATION COMPANY (MCAUTO)

MCAUTO's 1982 CAD/CAM revenues of $43 million represent 3 percent of the total CAD/CAM market, and 6 percent of the mechanical segment, the only market area in which the company was involved in 1982. In 1983 McAuto will begin marketing a PCB design system as well. MCAUTO has been an internal developer/user of CAD/CAM for several years, and is now moving more aggressively into the commercial marketplace. The company offers an extensive line of mechanical design and manufacturing automation software and has stepped up marketing efforts significantly in 1983. DATAQUEST estimates that MCAUTO's 1983 revenues will be approximately $60 million.

2.4.9 GERBER SYSTEMS TECHNOLOGY, INC.

Gerber Systems Technology, with 1982 revenues of $22 million, participates in the mechanical segment of the CAD/CAM industry. The company lost market share in 1982, as did most of its competitors, due to IBM's impact on this market segment. DATAQUEST estimates that Gerber System's 1983 revenues will be approximately $25 million, an increase of 8 percent over 1982.

Gerber Scientific, the majority stockholder in Gerber Systems Technology, sells PCB design systems and large photoplotters for PCB activities. CAD/CAM-related revenue for Gerber Scientific was approximately $20 million in 1982. Gerber Scientific's results are classified in the "Other-Turnkey Cos." category and are not reflected in the Gerber market share numbers presented in CCIS Volume I, Chapter 2, and CCIS Volume II, Appendices A and B.

2.4.10 PRIME COMPUTER, INC.

Prime's 1982 revenues of $51 million represented 4 percent of the total CAD/CAM market, reflecting Prime's rapid growth, principally in the mechanical market sector. Prime's hardware, its large installed base of engineers, and its state-of-the-art software for mechanical CAD accounted for its rapid growth as a CAD/CAM vendor. DATAQUEST anticipates more aggressive marketing efforts from Prime in 1983, making the company a viable contender in the CAD/CAM industry.

2.4.11 SPERRY CORPORATION

Sperry entered the mechanical CAD/CAM market in late 1981 and generated revenues of approximately $1 million. DATAQUEST estimates that the company's 1982 revenues rose to $3 million.

During 1982, Sperry's marketing efforts increased significantly in conjunction with the announcement of its Unis CAD system, which offers a full range of mechanical design and manufacturing capabilities. The system, which is based on the Series 1100 mainframe, provides greater capability than a minicomputer-based system and offers a full range of design, analysis, and manufacturing software.

DATAQUEST believes that Sperry should experience rapid growth in 1983, emerging as a significant competitor in the CAD/CAM market.

2.4.12 CONCLUSION

In 1982, the first signs of a major shift in the CAD/CAM industry became evident. Computer companies entered the market and participated aggressively; the impact of IBM on the mechanical design market was the most notable example. Companies with established market share in this application area experienced a loss of position to IBM. Coupled with an overall slowing of the industry's growth rate, the entry of computer companies outlined challenges for all competitors in the CAD/CAM industry.

During 1982 computer companies continued their penetration of the CAD/CAM market. Estimated 1982 revenues of $441 million represented a total market share of 31 percent for these computer companies. DATAQUEST believes that the overall industry growth rate should rise to 49 percent in 1983 and continue at slightly less than that level over the next five years. In our opinion, computer companies will grow at a rate of 50 percent during this period, versus a 41 percent rate for turnkey vendors. DATAQUEST believes that computer companies will have increased their total market share to approximately 38 percent by 1987.

An analysis of growth rates and market shares by application area reveals a number of considerations. In the integrated circuit design area, DATAQUEST expects a compound annual growth rate of 47 percent over the coming five years, representing an increase of from 8.7 percent of the total market in 1982 to 9.0 percent in 1987. However, we do not expect this market to return to the levels noted in 1977 (16.5 percent of the total market), indicating continued close competition for companies such as Calma and Applicon. The significance of this competition in the integrated circuit design area will be heightened until an economic recovery occurs in the semiconductor industry.

Within the mechanical market segment, significant growth occurred between 1977 and 1982; the mechanical area grew from 32 percent to 54 percent of the total market. DATAQUEST projects a growth rate of 45 percent over the coming five years for this segment, and expects it to account for 55.2 percent of the CAD/CAM market by the end of the period. DATAQUEST expects computer companies to continue aggressive market penetration in this area. Companies such as Calma and Applicon, with ties to General Electric and Schlumberger, respectively, are in a position to effectively address both the mechanical design requirements of this market and the CAM requirements, an area largely ignored until recently. Along with Computervision, the industry leader, these companies will face strong competition from computer companies offering large, mainframe-based systems to address their customers' manufacturing requirements.

DATAQUEST expects the printed circuit board design market to grow at an estimated 47 percent through 1987, representing 17 percent of the total market. Furthermore, DATAQUEST believes that computer companies will step up their efforts in this area, and will attain a 26.5 percent market share by 1987.

Growth in the AEC area is expected to average 41 percent through 1987, slightly behind the overall CAD/CAM industry. Intergraph, with 1982 revenues of $156 million, is expected to remain the industry leader, with an estimated 1987 market share of 40 percent.

Other trends related to user requirements became apparent in 1982, and will be important to all CAD/CAM industry participants in the future. As hardware costs continue to decline, the demand for sophisticated applications software, data base management, and communications capabilities will significantly impact the industry. DATAQUEST believes that the market will demand more integrated engineering solutions. Users will require systems incorporating CAD/CAM, analysis, manufacturing, and text handling. This requirement will generate a demand for computing resources in excess of those currently required by today's CAD/CAM systems.

DATAQUEST believes that the shift from 16-bit to 32-bit computers seen in today's market is the forerunner of the improved price/performance ratios required as companies move to maximize productivity and efficiency. Together with the trend toward a clustered system environment, with the requisite data base standardization and communications capabilities, this trend should spur competition among vendors, with niches opening for companies of all sizes.

2.5 U.S. and Non-U.S. Markets

Because of the application mix that has evolved in the CAD/CAM industry (primarily mechanical, electronic, and architectural design) strong markets for these products have emerged in the major industrial centers of the United States, Japan, and Western Europe. While all of the major vendors of turnkey CAD/CAM equipment are U.S. companies, CAD/CAM equipment has been aggressively marketed and well received in Japan and Europe almost from the very beginning of the industry. To date, however, only one major Japanese or West European entry in the turnkey or computer market has emerged on the scene--Racal-Redac. Several Japanese companies plan to market electronic design systems; Fujitsu has had success marketing CADAM, from Lockheed, in Japan. Successful software packages have also been developed in Western Europe, especially in Cambridge, England.

2.5.1 NON-U.S. MARKET

As Table 2.5.1-1 indicates, DATAQUEST estimates that revenues from non-U.S. sales contributed to the growth of turnkey CAD/CAM companies over the past five years.

In fact, the non-U.S. market sector of the worldwide CAD/CAM market grew faster than the U.S. domestic sector over the 1977 to 1982 time period, reflecting the increasing importance of the non-U.S. market to the CAD/CAM industry.

Table 2.5.1-1

ESTIMATED CAD/CAM
U.S. AND NON-U.S. REVENUE 1978-1982
(Millions of Dollars)

	1978	1979	1980	1981	1982
United States	$120	$224	$401	$645	$949
Non-U.S.	$ 43	$ 85	$180	$329	$487

Source: DATAQUEST

2.5 U.S. and Non-U.S. Markets

DATAQUEST estimates of the distribution of non-U.S. CAD/CAM revenues for 1982 are shown in Table 2.5.1-2. The Japanese and West European markets have potential for rapid growth in the next five years. The major hurdle for U.S. suppliers is one of overseas marketing support. This is possibly an area of advantage for the computer companies that have been marketing products in Europe and Japan since the late 1960s.

As shown in Table 2.5.1-3, sales of systems in the non-U.S. area for mechanical design applications rose as a percent of the worldwide total from 1978 to 1982. This rise is attributed to a strong marketing effort in Western Europe and Japan by Computervision and IBM. DATAQUEST expects this trend to continue, owing to Computervision's continued efforts in Japan and Western Europe, and to Applicon's new presence in the European market. We believe that the non-U.S. market for mechanical design systems will continue to increase in importance over the next five years, owing to the growth of the Japanese and European markets and to the opening of new markets for CAD/CAM systems.

Table 2.5.1-3 also indicates the decreased importance of the non-U.S. market for systems used in electronic applications. This decrease may be attributed to the continued strength of the U.S. semiconductor industry. However, the increasing strength of the domestic sales and marketing organizations of the two leaders in this area, Calma and Applicon, is also important here. These companies have made major efforts to expand the domestic electronics market; their concentration is reflected in the relative decline in the importance of the non-U.S. market. DATAQUEST does not expect this trend to continue, however, owing to the anticipated strength of Japanese semiconductor companies, and to the increased efforts we anticipate from Applicon in Western Europe.

The increased importance of the non-U.S. market to the AEC systems market is also shown in Table 2.5.1-3. DATAQUEST estimates that the non-U.S. market will continue to increase in importance relative to the U.S. market, owing to Intergraph's expected increasing presence in Western Europe.

Overall, we expect non-U.S. sales of CAD/CAM systems to approach and perhaps surpass 37 percent of total worldwide sales by 1987.

Western Europe

Three companies in particular--Calma, Computervision, and IBM--have made marketing efforts in Western Europe that have paid dividends. Computervision's sales and service operations in Western Europe are larger than that of all other major turnkey vendors combined and have netted the company a dominant place in the West European market. The

2.5 U.S. and Non-U.S. Markets

Table 2.5.1-2

ESTIMATED NON-U.S 1982 REVENUE DISTRIBUTION
(Millions of Dollars)

	Revenue	Percent
Western Europe	$245	50%
Japan	203	42
Canada	24	5
Rest of World	15	3
Total	$487	100%

Table 2.5.1-3

ESTIMATED NON-U.S REVENUE
AS A PERCENT OF TOTAL WORLDWIDE REVENUE
(Millions of Dollars)

	1978		1982	
Application	Revenue	Percent of Total Revenue	Revenue	Percent of Total Revenue
International Mechanical	$13.5	8%	$294	20%
IC	10.0	6	25	2
PC	12.0	7	97	7
AEC	4.5	3	54	4
Mapping--Other	3.0	2	16	1
Total*	$43.0	26%	$487	34%

* Slight variations in totals reflect rounding.

Source: DATAQUEST

percent of Computervision's total revenues attributable to European sales and service rose steadily to approximately 34 percent in 1982. IBM has had moderate success in Europe with less than 15 percent of its CAD/CAM revenues derived there. It is probable that IBM's success in the European CAD/CAM market is due to its dominant position as a computer supplier in Western Europe. Calma's total revenues attributable to West European sales and service have not been as great as those for Computervision, but we estimate that they were in the range of 12 to 18 percent in 1982.

DATAQUEST believes that the West European marketplace will continue to grow as a factor in the CAD/CAM industry. DATAQUEST also believes that Applicon, Intergraph, Prime, and Sperry will develop major positions in the West European market. Companies that have pursued an aggressive marketing strategy in Western Europe have had successes--from Scandinavia to Italy, and across all application areas.

Japan

Four companies, Applicon, Calma, Computervision, and IBM, have maintained major positions in the Japanese marketplace. Calma and Applicon have distributorship agreements with major Japanese trading companies to take advantage of the Japanese electronic circuit design market. Calma has also had success in marketing its mechanical design product through its Japanese distributor. In 1982, Computervision Asia continued to strengthen its marketing efforts in Japan, and the company's direct sales and service organization generated increased revenue for the company in Japan. IBM, again relying on its installed base and established marketing organization, generated as much as 40 percent of its CAD/CAM revenue in Japan.

However, the major suppliers in Japan, based on 1982 revenues, were IBM and Fujitsu in the number one and two positions, respectively. Computervision was third, Calma fourth, and Applicon fifth. Moreover, DATAQUEST estimates that there are another 24 CAD/CAM vendors in Japan that will increase their market share in the future, at the expense of the current top five suppliers.

Rest of World

DATAQUEST estimates that non-U.S. revenues for sales and service outside of Canada, Japan, and Western Europe are currently less than 5 percent of the non-U.S. total, although distributorships for U.S. turnkey CAD/CAM companies exist in Australia, Latin America, Mexico, and South America. We believe that two companies, Computervision, with its market share lead, and IBM, with its worldwide marketing resources, will have the capability to develop this untapped world market for CAD/CAM systems in the next five years. Calma and Applicon, with the corporate resources of General Electric and Schlumberger, respectively, could also emerge as important suppliers of CAD/CAM to the third world over the next five years. The industrial and natural resource development, which we believe will take place in Asia, Latin America, and the Middle East in the next decade, should make these areas major future markets for the CAD/CAM industry.

2.5.2 U.S. MARKET

Table 2.5.2-1 presents summary data on the U.S. market for turnkey CAD/CAM system revenues for the period from 1978 to 1982.

The overall U.S. market for turnkey CAD/CAM systems experienced a compound annual growth rate of 66 percent in the years from 1977 to 1982. Because all of the turnkey vendors are U.S. companies, they have tended to develop their U.S. sales and service operations to a higher level than their non-U.S. operations. In fact, companies such as Gerber and Auto-trol have focused almost all of their efforts on the U.S market.

Table 2.5.2-2 shows U.S. market share from 1978 to 1982. The entry of computer companies has changed the actual market share percentages of the turnkey firms compared to the total market; however, the dominant position of Computervision remained unchanged through the end of 1982.

Table 2.5.2-1

ESTIMATED U.S. REVENUE FOR
CAD/CAM SYSTEMS
(Millions of Dollars)

	1978	1979	1980	1981	1982
U.S. Revenues	$120	$224	$401	$645	$949
Percent of Worldwide Total	74%	73%	69%	66%	66%

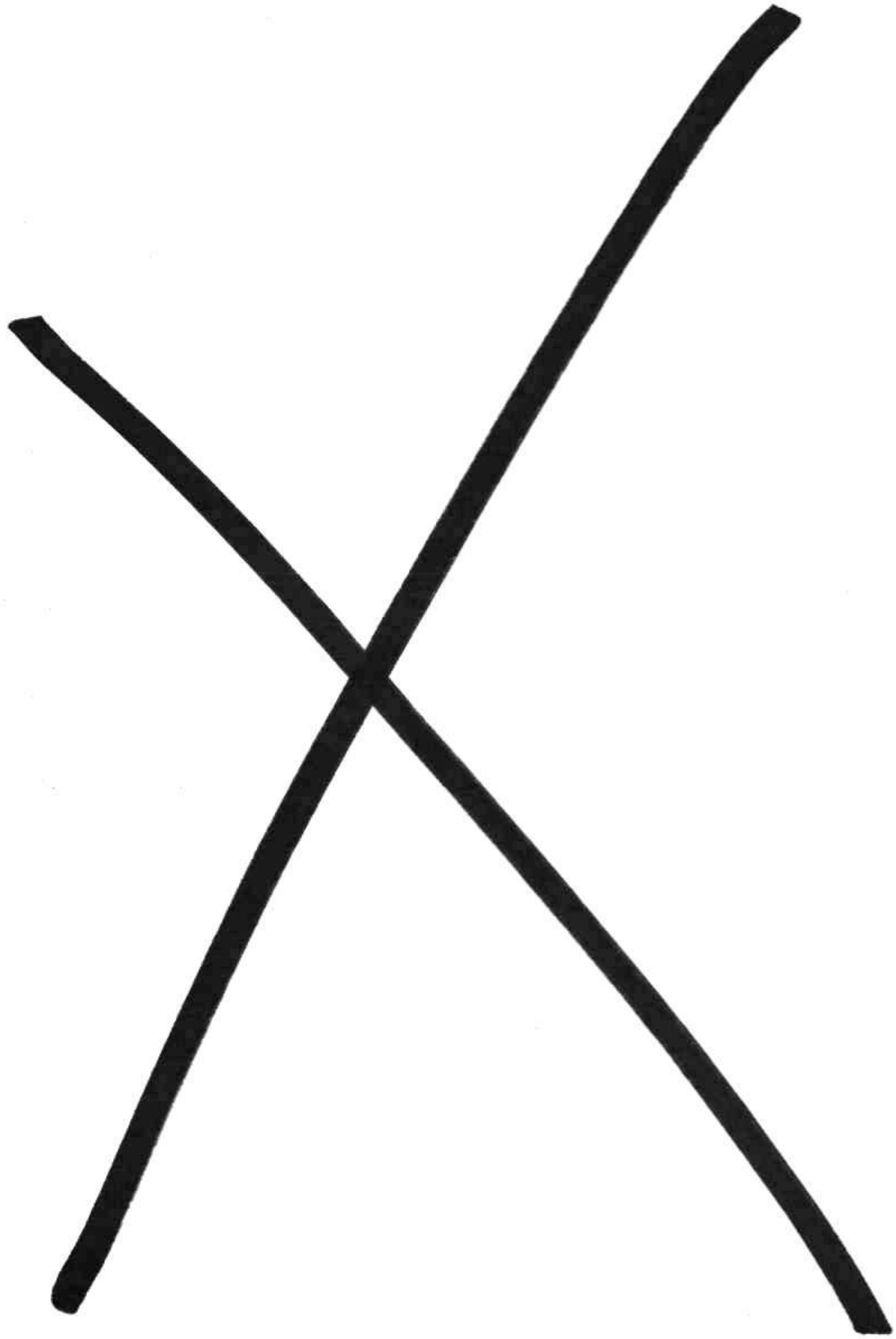
Table 2.5.2-2

U.S. MARKET SHARE FOR
CAD/CAM SYSTEMS SHIPPED

Company	1978	1979	1980	1981	1982
Applicon	14%	16%	15%	10%	6%
Auto-trol	14	11	10	6	4
Calma	12	11	9	12	11
Computervision	23	28	28	24	17
Gerber	6	5	4	3	2
Intergraph	9	7	8	8	12
McAuto	0	1	3	5	3
Other Turnkey Cos.	21	19	19	22	31
Digital	0	0	0	1	2
IBM	0	1	3	5	6
Prime	0	0	2	2	4
Sperry	0	0	0	0	0
Other Computer Cos.	0	0	0	2	2
Total*	100%	100%	100%	100%	100%

*Slight variations in totals reflect rounding.

Source: DATAQUEST



Technology Summary

SUMMARY

Increasingly complex engineering and manufacturing processes, coupled with requirements for increased worker productivity, have become prime motivations for industry and government to invest in and utilize CAD/CAM systems. Since the introduction of the first commercial system in 1969, CAD/CAM technology has made a major contribution to increased productivity across a number of vital industries. Expanding from limited drafting capabilities, current CAD/CAM technology is poised at the threshold of major advances in engineering applications, such as automated LSI and printed circuit board design and three-dimensional solid-element modeling. Using 32-bit system architecture, these systems will offer users design rule check (DRC) programs for LSI chips having hundreds of thousands of gates, and volumetric, element strength, and properties analysis of true three-dimensional models.

Manufacturing applications for CAD/CAM equipment will expand to include a larger variety of numerical control (N/C), materials management, process planning, and work scheduling functions.

Most CAD/CAM equipment will offer such features as virtual memory functions, with high-speed (100,000) bits per second (BPS) I/O ports for printers, plotters, and color display terminals. Significant technology advances in microprocessor and metal oxide semiconductor (MOS) processing technology will allow these machines significantly higher processing speeds for internal data transfer and peripheral data transfer (e.g., magnetic media).

The new generation of wide-word "super-mini" computers will provide the user community with the computing power to speed throughput, manage data, and perform sophisticated engineering analysis tasks, all at a cost that will be affordable to even small- and medium-size companies. It is expected that major turnkey vendors will remain tied to their traditional computer and peripheral suppliers, but will design and manufacture their own specialized interface and graphics processors to enhance user "friendliness" and productivity.

The overwhelming importance of applications software will be one of the major factors determining CAD/CAM growth during the 1980s. Instead of writing their own customized software (as a few companies currently do), users are looking to turnkey vendors to provide complete software packages ranging from pure drafting packages to ultrasophisticated electrical and mechanical design analysis programs. Vendors will be hard pressed to satisfy all these requests, given the current shortage of high-level graphics programmers and customer support personnel. It is expected that software houses will be called upon to bridge the gaps where vendors are unable to do so.

Technology Summary

The technology used in computer peripherals continues to advance very rapidly, particularly in the field of magnetic storage devices. Major advances in disk drive technology have made possible storage densities of 800 tracks per inch (TPI) and 15,000 bits per inch. Further head and media developments promise even greater data densities. Microprocessor control and large-scale integrated circuitry also have enabled disk drive suppliers to provide devices with increased performance and capacity in a smaller package with a lower price. The increasing use of small Winchester-type disk drives in one- and two-station CAD/CAM systems offers users substantial increases in storage capacity and convenience when compared with systems using floppy disk drives. Continued developments in the floppy disk drive area also will impact CAD/CAM applications. Several companies have announced and demonstrated floppy disk drives using media in the 3- to 3.5-inch range. The drives are approximately 4 inches wide, 2 inches-high, and 5.1 inches deep. Storage capacities are in the range of 400 Kbytes per surface. These devices are particularly interesting because of the improvements made in the floppy media packaging. The new designs use "shutter" arrangements to seal the media when it is outside the drive mechanism. The floppy envelopes of the new media are made of a semi-rigid plastic that can accommodate rough handling. Finally, the center hub of the media has been strengthened by developing a metal hub for precise centering.

Magnetic tape technology has undergone a similar transformation in recent years. Increased data densities from the current 6250-BPI, 9-track designs (1/2-inch tape) are expected shortly. Industry participants currently are working with 19-track, 20,000-BPI devices, with even higher data densities possible. Several tape cartridge designs also have been successfully marketed, including a recently offered one-half inch tape cartridge product offering 90 Mbytes of storage in a 5- X 5- x1-inch cartridge.

Even more advanced recording technologies are being pursued in research centers. Laboratory tests have demonstrated perpendicular recording techniques, offering a 10-fold improvement in data density per unit area. Optical recording techniques also show great promise, particularly in regards to read-only memory devices. At the 1982 Hannover Industrial Fair, N.V. Philips demonstrated a 2-inch laser disk memory capable of reading and writing 2 Mbytes. Through the marriage of more sophisticated control systems and these lower-cost, higher-performance magnetic storage peripherals, many CAD/CAM applications will greatly benefit. Many of the present paper tape storage methods used with existing CAM N/C machines are considered among the first beneficiaries of these new devices.

Communications links connecting commercial CAD/CAM vendor systems are being aggressively pursued due to the inherent advantages of networking and timesharing, and because of government insistence on a unified graphics data base to be used on government projects. Most local data networks currently use hardwire techniques (up to 10,000 feet) for maximum data exchange rates. Within the next few years, satellite and microwave communication links of one million BPS will become more common and offer networking capabilities unavailable today.

Technology Summary

HISTORICAL TRENDS

The emergence of CAD/CAM as the major engineering tool of the 1980s points to the important role that semiconductors, and the minicomputers they made possible, have played in interactive graphics technology. Initially developed using mainframe computers and resulting from industry and university experiments in computer graphics, CAD/CAM remained behind the doors of several large engineering laboratories until the middle 1960s. With the introduction of Digital Equipment's PDP-8 computer in 1965 and Data General's Nova Series in 1968, the computer industry provided the low-cost, multitask machines needed for CAD/CAM applications.

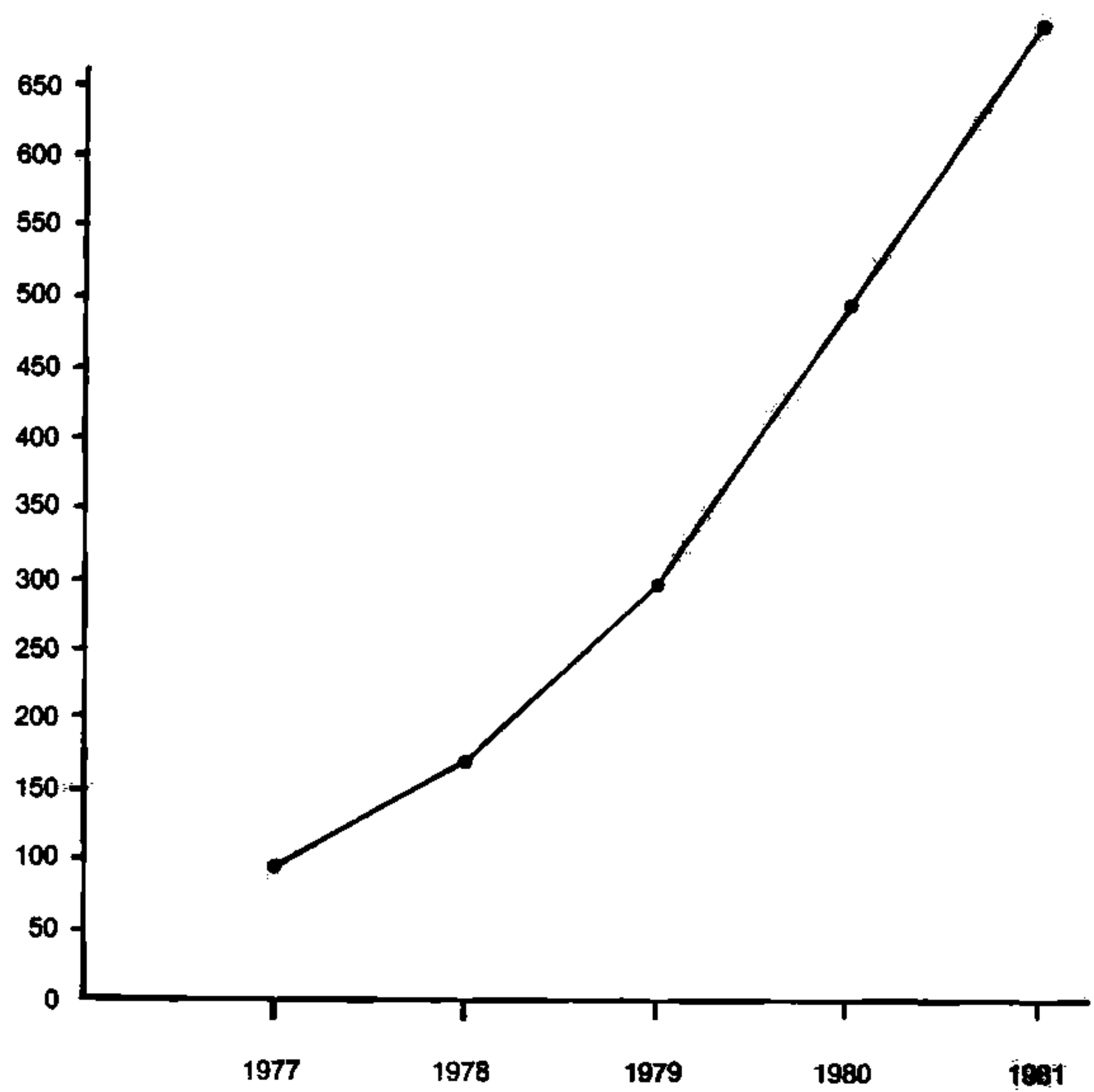
In 1969, two small companies located two miles apart in the famous I-128 area west of Boston, Massachusetts, introduced the first commercially available turnkey CAD/CAM systems. Applicon, Inc., introduced its Design DA 701 series using a PDP-11 and a 9-inch Tektronix storage tube. Shortly thereafter, Computervision Corporation introduced its CADDS 1 series with a Nova computer and an 11-inch storage tube display terminal. Compared with today's CAD/CAM systems, these systems were slow, cumbersome to use, and had limited software capabilities. They were first used primarily in the electronics industry for such applications as printed circuit boards, integrated circuits, and simple manufacturing drawings. These companies became known as "turnkey" suppliers, meaning that they provide all necessary hardware, software packages, hardware and software maintenance, and technical and educational support to their customers. Today, CAD/CAM graphics systems are typically installed and operational in one to two weeks after delivery at the customer's facility. This approach can save users hundreds of thousands of dollars in overhead expenses while software is being written and debugged, and while hardware is being integrated.

The first users of these systems were the large electronic manufacturing companies such as Hughes Aircraft Company, Motorola, Raytheon, and TRW. This was due in part to the high equipment cost (in 1969, $100,000) and the cost of system support, which, although provided by the vendor, sometimes required programming expertise to utilize.

During the early-to-mid-1970s, several companies in addition to Applicon and Computervision began to offer "turnkey" systems. CALMA, Inc., introduced its GDS system in 1972; Integraph Inc., introduced its IGDS system in 1973; and Auto-trol Technology introduced its AD380 system in 1975. As the cost of computers and peripherals decreased during the 1970s, the CAD/CAM industry found itself in an era of dynamic growth starting in the mid-1970s and continuing to the present.

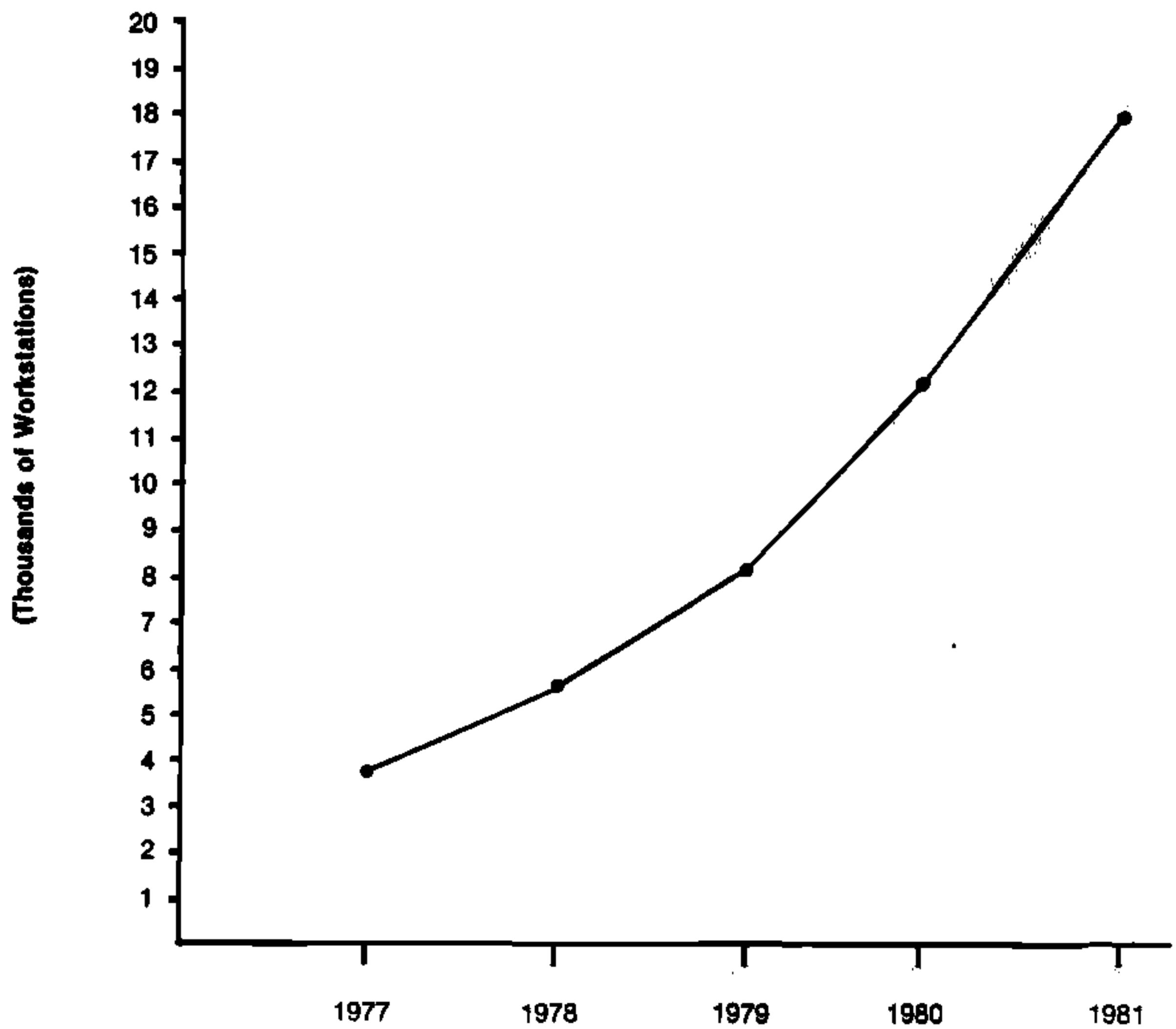
The annual revenue (for turnkey companies) shown in Figure 1 give a clearer picture of the rapid growth in the CAD/CAM industry. Figure 2 shows the rapid increase in the number of users of turnkey CAD equipment since 1977. As the competition increased during the 1970s, vendors directed a larger percentage of their sales revenues to research and development. Today, the industry leaders spend between 9 and 10 percent of their gross revenues on research and development.

Figure 1
TOTAL ANNUAL REVENUES FOR TURNKEY CAD/CAM COMPANIES
1977-1981



Source: DATAQUEST, Inc.

Figure 2
ESTIMATED INSTALLED BASE OF TURNKEY CAD/CAM WORKSTATIONS
1977-1981



Source: DATAQUEST, Inc.

Technology Summary

The early pioneering companies offering turnkey systems were joined by others reflecting the growth in demand for CAD/CAM technology. In the early 1980s, this core of turnkey companies was joined by a wave of start-up companies offering a variety of new approaches to marketing CAD/CAM equipment. These companies are rapidly approaching 50 in number, and their ability to push back the frontiers of CAD/CAM technology remains one of the interesting issues of the 1980s for the industry.

In addition to the onslaught of new turnkey companies, two other significant trends in the industry have developed in the early 1980s. The first of these is the entrance into the CAD/CAM industry of major worldwide corporations with the financial and technical resources required to bring the CAD/CAM industry to rapid maturity. In 1981, General Electric (with 1981 revenues of $25 billion) acquired CALMA; in the same year the French-based Schlumberger Corporation (1981 revenues, $4 billion) acquired Applicon. It is significant to note that rather than cope with the costs and efforts of developing CAD/CAM systems from scratch, these corporate giants chose to acquire existing companies. Future development of the industry may take a similar path. Major corporations the size of General Electric and Schlumberger have the capacity (in research and development, marketing, and manufacturing) to accelerate the growth of the market considerably, and conglomerate acquisitions appear to be a trend in the turnkey sector of the industry.

The other major trend in the CAD/CAM industry to emerge in the early 1980s is the increasing presence of computer companies in the marketplace. Computer companies differ from turnkey companies in that they generally offer third-party software packages and lower levels of customer support. Furthermore, they have tended to focus their sales efforts on multi-application requirements within their existing customer base. Until the early 1980s, computer companies were relatively minor actors in the CAD/CAM marketplace; however, this situation has changed. Two computer companies, Digital Equipment Corporation and IBM Corporation, are now major suppliers of CAD/CAM equipment; other companies, among them Control Data, Data General, Gould, S.E.L., Harris, Perkin-Elmer, and Prime Computer have come to recognize the potential in the CAD/CAM market and have increased their efforts in this area.

HARDWARE TRENDS

With a few notable exceptions, the CAD/CAM industry has not provided the world with major hardware innovations. The industry has, however, been very successful in adapting and applying existing technologies to the needs of CAD/CAM users. Perhaps the best examples were the original turnkey systems employing early versions of Digital Equipment and Data General minicomputers and Tektronix storage display tubes. The original CAD/CAM vendors were quick to note that the general purpose minicomputer was well suited to performing the computational tasks required for interactive graphics. In the same vein, they seized on the storage tube, originally designed for test equipment and radar applications, as a display device for their early CAD/CAM systems.

This same pattern of integrating and enhancing existing technology can also be said to characterize the pen plotter, the digitizing tablet, and later color and raster display and electrostatic plotter technologies.

Several of the largest CAD/CAM vendors now manufacture their own graphics processors and associated interface modules. Computervision Corporation, which previously used Nova computers, developed its own 16-bit machine in 1974 (named the CGP100); it also produces intelligent graphics processors for its workstations. Applicon, Inc., which started with a PDP-11/5, has used the PDP-11/34 and PDP-11/35 for its systems since 1971. Applicon recently introduced its graphics controller interface for the PDP-11 that assumes many of the PDP graphics tasks and decreases response time considerably compared with earlier systems. CALMA, Inc., uses a 16-bit Data General Eclipse computer for its CPU, and integrates its own data interface unit with it. One company, Computervision, has taken the approach, unique in the industry, of vertically integrating its hardware. Since developing the CGP100 in 1974, Computervision now manufactures its own workstation components and plotters. This departure by Computervision is significant because it demonstrates the leading vendor's belief in the need to develop specialized hardware for CAD/CAM technology rather than adapting general purpose equipment for CAD/CAM uses. There is no indication that the other leading vendors will follow Computervision's lead here, although Applicon has developed its own ink jet plotter, and CALMA, with the vast resources of General Electric behind it, certainly now has the capability to develop specialized CAD/CAM equipment should the decision be made to do so.

As computer companies have concentrated on hardware development for CAD/CAM usage, they have tended to focus on the CPU and peripherals that they already manufacture. As of now, these companies have not moved into the manufacture of display devices or plotters. Even IBM, which traditionally has preferred to manufacture its own hardware equipment whenever possible, integrates a vector stroke display device manufactured by Sanders Associates for its CAD/CAM product offering.

Because CAD/CAM applications do not constitute a major category of usage for general purpose computers (as business, science, and general engineering do), CAD/CAM requirements have not had a major impact on the research and development planning of the computer companies either.

Virtually all CAD/CAM vendors purchase peripherals from OEMs such as Calcomp, Memorex, Ramtek, Tektronix, Texas Instruments, Versatec, and Xynetics. This trend is expected to continue throughout the 1980s due to significant manufacturing and economic benefits among OEMs, CAD/CAM vendors, and users.

Technology Summary

Peripheral devices have traditionally comprised 70 percent of CAD/CAM system hardware content, and little change is indicated in the future. Increased peripheral performance will benefit CAD/CAM users, specifically in the disk drive, CRT terminal, and hard copy plotter technology areas. In the period 1967 to 1980, the cost per Mbyte of disk storage has decreased 20-fold. Most turnkey systems sold today offer 150 to 200 Mbyte disk storage capabilities as standard equipment, with additional drives as options. This is a major increase from the standard 30- to 70-Mbyte drives sold during the early-to-mid-1970s. Advances such as the introduction of Winchester-disk technology have produced even greater data densities while eliminating regularly scheduled drive maintenance. As on-line capacity and reliability have increased, the removability feature of disks has diminished in importance.

CRT resolution is expected to improve from the present 1,000-line resolution for raster display tubes to 4,000-line resolution, with an increase in the maximum number of colors available to the user.

Special device technology such as photoplotters, pen plotters, electrostatic plotters, CRT film recorders, E-Beam, and line printers are expected to improve substantially during the 1980s. Photoplotters, used by CAD/CAM systems to generate high-precision art masters for electronic component and printed circuit board fabrication processes will exhibit significant design improvements using fiber optics and/or laser technology. These improvements should increase productivity from these devices approximately 300 percent while simultaneously increasing resolution.

Pen plotter drawing speeds will triple from the present 2,400 inches per minute (IPM) using laser printer technology. Electrostatic plotters will become slower relative to laser plotters but will be far less expensive for acquisition and operation.

CRT film recorders will become standard system hardware similar to black-and-white hard copy units when they are improved to deliver a full-color, high-resolution image at a reasonable cost. Present recorders consume large amounts of space and materials, and the cost per image can exceed five dollars. Film processing times usually require several hours at additional cost.

Electron-beam techniques that bypass requirements for artwork generation and directly etch circuits into semiconductor material will expand in their capabilities. These machines, presently at the one-micron accuracy level, are being refined to operate below the optical limit.

DATA BASE MANAGEMENT AND COMMUNICATION TRENDS

As turnkey CAD/CAM manufacturers develop larger and more sophisticated software packages, strong user interest in extensive data base management and communications controls will force development of more comprehensive management procedures. Accounting, data security, and system performance modules for most mini-based CAD/CAM systems still lag behind today's mainframes. As communication capabilities increase, higher data transfer techniques between remote locations will be needed, along with management control for user access.

With the exception of CADAM, a subsidiary of Lockheed Corporation, turnkey vendors have offered limited communication interfaces between similar systems at remote locations. CADAM, which is usually operated on a timeshare basis in conjunction with business and engineering applications using a 3033 mainframe, has benefited from IBM's expertise in distributed processing.

Since 1980, Computervision has offered a networked version of its Designer system using one of the CPUs as a data controller, thus allowing a user to access information files from other Computervision systems in the network. Also offered is CVNet, which uses telephone modems to transfer information between remote sites. Applicon has offered access to DECNET from its AGS systems. Unfortunately, data exchange rates (for extended distances) are at the 9,600 baud level, which poses significant system response problems.

Due to the complexity and size of graphics data bases, normal data transfer through the use of modems, using protocols such as HASP, 2780/3780, MUX200, or X.25 is usually frustrating to operators (due to slow response time) and can result in a 50 percent loss in productivity.

With the introduction of 32-bit computers and the availability of satellite communication links, CAD/CAM users will have almost unlimited networking capabilities opened to them. Data transmission rates of one million bits per second will be able to provide near-real-time communications for most users until the late 1980s. By then, higher data rates will be needed to handle the more sophisticated computers that will become available.

One of the largest problems to be resolved in the early 1980s is the incompatibility of software among vendors. Currently, every vendor is either totally or nearly totally incompatible with other vendors. For vendors, this has had the advantage of creating a captive user market, but this situation will certainly change during the next five years as pressure is increased to provide a "universal" data base containing all desirable attributes from all commercial systems. Several efforts are now under way. Most are sponsored or co-sponsored by the U.S. Government, which is trying to standardize the industrial data base supporting government projects.

Currently under development by the U.S. National Bureau of Standards, Boeing Commerical Aircraft Co., and others, is a project called Initial Graphics Exchange Specification (IGES). The goal of the project is to develop a set of parameters that would permit a graphics data base to be portable from one commercial CAD/CAM system to another. The theory is that contractors specialize in one area, and developing the best design approach is easier if data bases are interchangeable. The IGES project is expected to continue until 1984.

Another standard that has been created is the IPC-D-350 format. It was developed by the Institute for Interconnecting and Packaging Electronic Circuits, and its goals for portable data bases are similar to IGES. The IPC format can be achieved by transferring a graphics data base from a turnkey CAD/CAM system and manipulating it through a mainframe translation program. The resulting code can be read into many CAD/CAM systems without further processing. This format is currently a requirement on several government contracts in the aerospace industry.

In addition, Computer-Aided Manufacturing International (CAM-I) has a number of programs and projects to advance the development of CAD/CAM techniques by organizing member companies to fund joint research and development efforts and share in the benefits.

COMPUTER TRENDS

The typical computing engine of a CAD/CAM turnkey system today consists of a 16-bit minicomputer connected to a mass storage device (usually a hard disk), peripherals such as pen and photoplotters, paper-tape punches, and the CRT workstation. The workstation includes a keyboard, digitizing pen and tablet, and function keyboard. The number of workstations varies, depending upon the types of CRT tubes, computer memory, and software applications, but is usually between two and four terminals. Some large mainframe systems support up to 200 terminals, but fewer than 50 of these systems are installed.

While today's typical system (sometimes known as a "cluster system") will continue to prevail in the short term, two major trends have emerged in computer usage for CAD/CAM systems. The development efforts of the mid- and late 1970s by computer and semiconductor companies have resulted in commercial offerings of general-purpose 32-bit minicomputers and 16-bit microprocessors that will be easily integrated into the CAD/CAM system environment.

As 32-bit machines are introduced during 1982 and 1983, significant increases in the number of terminals and increases in system response time will benefit users. Virtual memory capabilities, high-speed I/O ports, and 1,000 lpm printers should also become standard equipment. State-of-the-art technology and ergonomic improvements will be incorporated into workstations accompanying these systems. Microprocessors to handle the graphics subroutines should provide increases in computational speed, network communications, and higher productivity through faster display of complex designs and associated parametric data.

Phenomenal technological leaps in microelectronics (some of which can be attributed to the CAD industry itself) have lead to very powerful "computers on a chip." These devices have made it economically feasible to devote a single CPU to a single workstation, either standing alone or functioning within a network. Such systems are beginning to appear in the CAD/CAM marketplace under the rubric of "engineering workstations."

Technology Summary

These systems are typically relatively inexpensive owing to their low-cost hardware components and, for the first time, will make CAD/CAM technology affordable to the lower tier of industry.

SOFTWARE TRENDS

Operating Systems

Perhaps the largest change in operating system programming arising from the introduction of 32-bit machines will be the availability of virtual memory systems (VMS). Virtual memory architecture allows the computer to swap data between its memory and storage devices, creating a virtually unlimited computational capacity.

Most of today's CAD/CAM 16-bit minicomputers have a fixed memory size and are instruction-size restricted. This can cause system limitations when handling large analysis programs or data bases. Additional advantages in having 32-bit architecture include faster calculating functions due to a larger word size (32 vs. 16 bits), and programming options using data types such as long word (4 bytes) and quad word (8 bytes) instead of the present one-word capability.

In the area of operating system languages, most vendors will continue to use a combination of lower level and higher level code for maximum computer efficiency. Typical examples of languages are ASSEMBLY, COBOL, and FORTRAN IV. These languages are translated through compilers into microcode for actual program execution.

Microcode, which controls the actual electronic components in the computer such as chip gates, flip-flops, registers, and arithimetic logic units, is an extremely compact and precise instruction set for the computer to use. An unfortunate drawback to a microcode or assembly type language is that while it operates the computer very efficiently, writing the code is a very exacting and time-consuming task. Because of this situation, microcode, ALGOL, and ASSEMBLY are used by CAD/CAM vendors only for functions that consume the most overall CPU time. In contrast, high level languages such as FORTRAN IV and COBOL are used by CAD/CAM vendors and software houses for programming functions such as controlling the graphics displays, object rotation, Finite Element Modeling, Solids Modeling, and circuit trace autorouting. These functions involve complex mathematical computations, and FORTRAN IV and COBOL allow programmers to write large amounts of code in an efficient and easily readable manner.

While an unknown factor at this time, the introduction of single-terminal, low-cost, CAD systems may give BASIC the opportunity to become a prevalent CAD/CAM language. The proliferation of the business microcomputer is creating a sizable BASIC programming base that could migrate into CAD/CAM programming applications.

Technology Summary

Applications Software

There are four application areas currently being developed to increased levels of sophistication: integrated circuit design software, printed circuit design software, three-dimensional design and analysis software, and Architecture, Engineering, and Construction (AEC) software. Figure 3 shows the relative importance of each of these application areas to the CAD/CAM industry.

Integrated Circuit Design

In the area of LSI, VLSI, and very high-speed integrated circuit (VHSIC) design, the latest design software allows a user to create a segment of the circuit, assign a graphic symbol, and complete the circuit using just the symbol. CAD/CAM vendors name a collection of these circuit segments a "component library." Once created, these components can be reused in future designs without additional modification. Optional design automation operations include having a design rule check (DRC) program analyze the circuit for clearances, spacing, dissimilar materials, and interconnect width correctness. The STICKS software program offered by CALMA can perform these functions interactively with the circuit designer.

Applicon's CASL (Color Assisted Symbolic Layout) package provides the user with graphic symbols for circuit layout, DRC for correct Boolean functions, overlap and enclosure check of entities, and highlighting of violation areas.

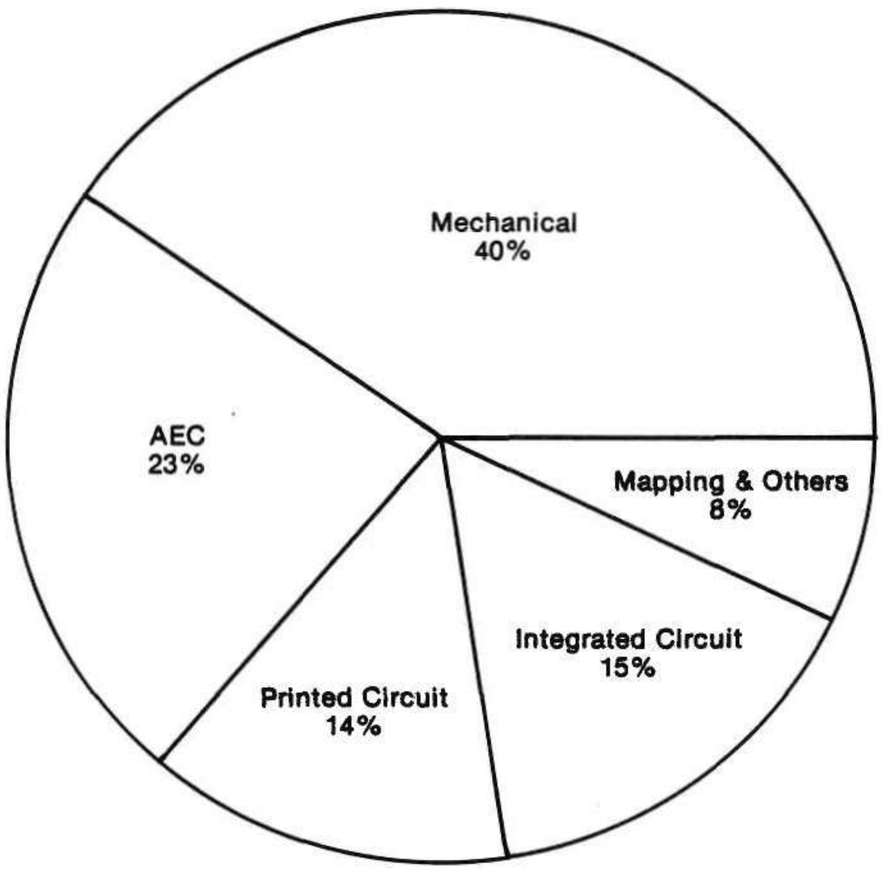
After the circuit has been completed, a magnetic tape is prepared to operate either a pattern generator or electron-beam substrate etching machine. The pattern generator provides a film artmaster for photolithographic fabrication of the device. The electron-beam (E-beam) machine directly etches the pattern into the substrate material. Due to the speed and accuracy inherent in E-beam techniques, which are currently at the sub-micron level, they are rapidly becoming the accepted fabrication standard for LSI and VLSI devices.

Current CAD/CAM software for designing integrated circuits provides the capacity for more than 500,000 gates per chip. As the demand for 64K and 128K RAM devices expands, the software capability will enlarge to more than two million gates by 1990. Integrated circuit software currently in development includes automatic circuit routing and total interactive circuit simulations.

Printed Circuit Design

The printed circuit design area has been a CAD/CAM primary application since 1969. Maturing from manual input methods (digitizing), most systems today offer semi- or totally automatic component placement and circuit routing. Using a set of vendor-supplied algorithms, the circuit designer can specify a small area or the entire circuit to be routed, using several algorithms including horizontal, vertical, maze, and all-inclusive search. The designer interactively uses the computer's mathematical capabilities and his own creativity and ingenuity to complete the circuit.

Figure 3
1980 ESTIMATED CAD/CAM REVENUES BY APPLICATION AREA



Source: DATAQUEST, Inc.

After completion, program outputs include net lists, photoplotter tapes, and numerical control (N/C) tapes for drills and mills. Net lists are a description of the interconnects of the circuit. For example, "Device 1, pin 2 - Device 3, pin 14" would be one line of a net list. By comparing the net list to the circuit schematic, either by using DRC or manual methods, the designer can verify all circuit connections.

A photoplotter is a device that exposes a photographic artmaster for circuit fabrication. The N/C tapes control machines that drill holes for component insertion and milling of the circuit card from stock to specification sizes.

Mechanical Design

Three-dimensional mechanical design and analysis are also areas where innovations are taking place. Several software packages offered today permit the creation of an object (machine, product, or figure), using "solid building blocks." The user can then color, shade, or rotate the object. The computer can calculate surface volumes, moments of inertia, material weight, material thickness, and thermal expansion from the data base. Several of the turnkey CAD/CAM vendors presently use their systems to construct a "wire mesh" model and then transfer the data file to a 32-bit computer for full solid-model processing. The enhanced data base is then returned to the turnkey system for further graphics manipulation. With the introduction of 32-bit turnkey systems, the transfer operation will be eliminated. Solids modeling packages are available from sources such as Applicon, CALMA, Computervision, Evans & Sutherland, and MAGI.

Most mechanical design software users incorporate "group technology" into their design cycle. Group technology refers to using similar previous data bases as a baseline for a new design. For example, axles for trucks are designed by weight standards. All truck axles are considered a "group" and new axles are designed using some of the features of the existing axles. This methodology can create labor and computer time savings of more than 50 percent.

The mechanical analysis application area now offers several significant software capabilities. A turnkey CAD/CAM user can construct a solid object on his/her system, transfer to a 32-bit VMS machine, and analyze the design using such packages as Nastran, Pastran-G, SAP, or STARS. These programs perform finite element analysis (FEA), which allows an engineer to apply stress factors, load paths, and deflections onto a design and study its change from the original shape. Similar analysis packages are available to study the thermal, fluid, kinematics, and aerodynamics of computer-generated models.

After a design has been completed and tested by the various analysis packages, the information can be formatted for use by N/C machines such as drills, mills, lathes, and grinders for manufacturing. The present manual programming practices for these machines will be reduced through CAD-generated instructions.

Technology Summary

AEC Design

Architecture, Engineering, and Construction (AEC) software capabilities have increased substantially in the past four years. Due to intense user interest, the bill of materials (BOM) area has been further refined. After design completion of a building or structure, the architect can request the CAD/CAM system to output a list of all materials used in the design. The software will compute usage occurrence, volume of material area, material source, and the estimated construction cost using system-defined parameters and industry building code standards. Using the BOM, construction bids can be accurately evaluated and budgeted by the architect and builder.

Other outputs include construction drawings, heating, ventilation, and air conditioning (HVAC) drawings, and electrical wiring drawings. The mapping software available from most turnkey sources allows a designer or architect to study a geographic location and incorporate roads, railroad tracks, municipal boundaries, and bodies of water into his/her site elevation and landscape drawings. For example, the software will enhance a single line into railroad tracks by adding one additional line and the crossties at specified distances, even on curved line segments.

Additional applications software packages currently available include:

- Calculation of volumes and areas
- Data scanning (automatic digitizing)
- Figure animation
- Human engineering studies
- Inventory and production charts
- Voice synthesis
- N/C tape preparation verification
- Pattern recognition
- Production planning
- Seismographic analysis
- Sheet-metal layout development
- Slide production using color graphics
- Text editing
- Trajectory analysis
- Visual and plastic art applications
- Wind tunnel analysis

Technology Summary

Applications Trends

Since the original applications in the electronics, aerospace, and auto industries, the number of products designed with CAD/CAM has been growing weekly. Animation, costume design, integrated circuits, mechanical design, nondestructive testing, printed circuit boards, product packaging, mapping, and finite-element modeling are just a few of the hundreds of applications and software packages available from CAD/CAM vendors and software houses. It is expected that the library of applications software will continue to grow through the 1980s at the 50 percent per year sales volume set during the 1970s.

An interesting trend to be watched as software capabilities increase and are introduced is a question of who will operate the system? Will today's average user (typically a draftsman/designer) be able to operate these advanced systems, or will users need a sophisticated software education? A new "typical" user may become more prevalent in the mid- to late-1980s; this user will have substantially more programming and computer knowledge than today's user, who normally has more drafting knowledge. This situation will probably require support from educational and technical training institutions in computer science and engineering.

As CAD/CAM expands in both computational power and unified software packages it will be necessary to determine if the term "CAD/CAM" really describes its function. If the accounting department, materials planning department, shop floor control, and shipping departments are all tied into the same data base that engineering uses for product design, is the system really a computer-aided design/computer-aided manufacturing system or is it an MIS system?

It is difficult to predict software and applications developments even for one year in the future. CAD/CAM vendors are positioning themselves for market share penetration in two areas. The first is the large manufacturing market sector, which is where they have enjoyed traditional dominance and effected major changes. The second area is in the smaller engineering markets (companies under $30 million) that have been ignored for the most part. This market is expected to be the major battleground among competitors and should expand faster than the large manufacturing and engineering CAD/CAM market sector. Simple economics indicate that although there are far more companies in the $30 million range that would like to acquire CAD/CAM capabilities, they cannot afford the high cost of acquisition and maintenance required by the systems offered by most of today's turnkey vendors.

It is clear that in order to provide for the needs of this less sophisticated potential market, CAD/CAM vendors will have to provide applications software and software support. Major development efforts are now under way in all of the larger turnkey companies to provide the required applications software, and computer and software companies are also addressing this issue.

Introduction to Company Profiles

INTRODUCTION

This chapter discusses individual companies participating in or related to the CAD/CAM industry. Discussion of the companies is preceded by a CAD/CAM scoreboard, and each company profile is preceded by a financial profile.

Clients are encouraged to use their inquiry privileges when they want information about a company that is not provided here or in another section of the Source Notebooks. However, only information that is publicly available will be released.

Following is a brief description of the components that comprise the Company Profiles section of the CAD/CAM Source Notebooks.

SCOREBOARD

A CAD/CAM scoreboard is at the beginning of the Company Profiles Binder to illustrate industry norms and aggregate and company levels for key economic indicators of CAD/CAM companies. Companies are listed on the scoreboard by the following classifications:

- CAD/CAM
- Computer
- Graphics
- Other

FINANCIAL PROFILE

The financial statement is designed to present a brief summary of the financial highlights of the company for the last five of its most recently completed fiscal years. The information provided will generally be identical to that presented in the company's current annual reports and SEC Form 10-K. Below is a description of the components, sources (unless otherwise stated on the document), and/or means of calculating each item listed in the financial statement. Income Statement or Balance Sheet refers to the official financial statements of the company on which an audit opinion is expressed. Annual Report refers to other segments of the published annual report. Compound Annual Growth Rate (CAGR) is calculated as present value divided by beginning value, raised to the first power, divided by the number of years less one.

- Zero—"0" indicates data equal to zero.
- Hyphen—"-" indicates data nil or almost zero.

Balance Sheet Data

- Working Capital—Current assets minus current liabilities
- Long-Term Debt—Directly from Balance Sheet
- Shareholders' Equity—Net income after taxes, divided by one-half the sum of the current and previous years' stockholders' equity
- After-Tax Return on Average Equity—Net income after taxes divided by one-half the sum of the current and previous years' stockholders' equity

Operating Performance

- Revenue—Directly from income statement including sales, service, leases, and other revenue
  - U.S. (or other domestic) Revenue—Directly from annual report or Form 10-K
  - Non-U.S. Revenue—Directly from annual report or Form 10-K (when available)
- Cost of Goods Sold—Directly from annual report
  - Gross Margin—Total revenue less cost of goods sold
- Expenses
  - R&D Expense—Directly from annual report, Form 10-K, or income statement
  - SG&A Expense—Directly from income statement
  - Other Expense—Directly from annual report
- Operating Income
  - Interest Expense—Directly from income statement (when available)
  - Interest Income—Directly from income statement (when available)
  - Other Income (Expense)—Directly from income statement
- Income before Tax—Directly from income statement (before tax and extraordinary items)
  - Pretax Margin—Income before tax, divided by revenue

- Taxes
  - Effective Tax Rate—Provision for income tax, divided by pretax income
- Extraordinary Items—Directly from annual report
- Net Income after Tax—Directly from income statement excluding extraordinary items

Shareholder Data

- Average Shares Outstanding—Directly from balance sheet; if both primary and diluted are reported, only diluted is given
- Per Share Data
  - Earnings—Directly from Annual Report or Form 10-K
  - Dividends—From income statement
  - Book Value—Calculated as stockholders' equity divided by year-end shares outstanding
  - Price Range—Lowest and highest trading price of stock during the fiscal year from annual report.

Total Employees (Directly from Form 10-K)

- Revenue per Employee—total revenue divided by number of employees

LINE ITEMS AS A PERCENT OF REVENUE

The following items based on Operating Performance are indicated for each company as a percent of revenue:

- Revenue
  - United States
  - Non-United States
- Cost of Goods Sold
  - Gross Margin

- Expenses
  - R&D Expense
  - SG&A Expense
  - Other Expense
- Operating Income
  - Interest Expense
  - Interest Income
  - Other Income (Expense)
- Income before Tax
- Taxes
- Net Income after Tax

COMPANY CAD/CAM PERFORMANCE

Pertinent data have been selected from Dataquest's CAD/CAM data base and reorganized into two simplified tables for our clients' convenience. A five-year history is presented in the Positioning section of the Company Profile, in the following format:

- CAD/CAM Performance
  - Total revenue
  - Workstations shipped
  - Workstations installed
- CAD/CAM Percent Market Share History—All Applications and by Segment
  - By revenue
  - By workstations shipped
- Current market rank by segment

COMPANY PROFILE

The Company Profile is designed to provide the client with complete, comprehensive historical data on each company. Following is a summary of the information that is provided (where appropriate and available) on each company.

- The Company
  - Founded—History of company formation
  - Positioning—Description of overall business, five-year history of CAD/CAM performance, and market share
- Financial—History of company funding sources
- Highlights—Recent major events including major products and strategic alliances
- Organization—Personnel distribution, major divisions and functionality, facilities
- Marketing and Sales
  - Strategy—Focused on company CAD/CAM strategy
  - Distribution—Distribution channels worldwide
  - Locations of Sales Operations—Sales locations worldwide
- Sales Support
  - Warranty provisions
  - Maintenance agreements
  - Training offered
- Strategic Alliances—A summary of current agreements on the following:
  - Mergers and acquisitions
  - Joint developments
  - OEM agreements—Contracts with key suppliers or OEM customers
  - Joint marketing agreements
  - Cooperative marketing agreements

- Major Historical Milestones—Reverse chronological list of major accomplishments

- CAD/CAM Products

  — Market segment participation—Description of product offerings based on Dataquest's CAD/CAM market segmentation scheme

  — Product line—Hardware, software, configurations

Six Year Overview

	REV	COGS	GPM	R&D	SG&A	NIBT	NIAT	EMP
Cad/Cam companies								
1979	195	98	96	19	43	34	19	3,340
1980	298	139	160	31	72	59	36	4,955
1981	414	184	230	48	115	75	46	5,554
1982	551	261	290	70	154	75	46	6,616
1983	790	376	414	96	215	128	80	9,377
1984	1,296	587	709	145	345	226	135	13,202
1985	1,453	732	720	188	390	39	10	13,405
Graphics Companies								
1979	978	493	485	66	209	159	95	26,012
1980	1,297	681	616	86	279	181	110	30,910
1981	1,488	791	697	105	335	191	112	32,135
1982	1,711	956	755	116	377	191	117	32,265
1983	1,866	1,112	754	136	402	150	100	31,886
1984	2,197	1,292	905	747	445	213	167	32,308
1985	2,446	759	1,688	936	492	170	135	33,530
Computer companies								
1979	35,640	14,965	20,675	2,142	10,064	6,892	3,945	590,122
1980	37,997	16,406	21,591	2,348	11,191	7,243	4,389	556,357
1981	42,924	19,364	23,560	2,635	12,303	7,685	4,145	590,756
1982	49,278	21,276	28,002	4,263	12,845	10,038	5,529	596,825
1983	56,716	24,813	31,903	4,808	14,209	11,517	6,511	612,943
1984	64,569	22,031	42,538	6,138	16,120	13,179	7,803	443,672
1985	70,766	25,924	44,841	6,974	18,129	12,357	6,951	670,596
Other Companies								
1979	5,279	4,435	843	194	475	311	123	82,736
1980	6,067	5,242	825	199	589	157	144	82,550
1981	7,386	6,297	1,089	217	689	230	175	74,264
1982	7,358	6,103	1,255	260	768	319	209	72,758
1983	8,182	6,803	1,379	314	805	443	281	75,268
1984	9,817	7,972	1,844	397	1,097	177	348	90,118
1985	11,884	9,549	2,335	459	1,233	11,351	372	99,269
Grand Total								
1979	42,091	19,992	22,100	2,420	10,792	7,395	4,183	702,210
1980	45,660	22,467	23,193	2,663	12,132	7,641	4,679	674,772
1981	52,211	26,635	25,576	3,004	13,441	8,182	4,478	702,709
1982	58,898	28,595	30,302	4,708	14,144	10,623	5,901	708,464
1983	67,553	33,104	34,450	5,354	15,630	12,237	6,971	729,474
1984	77,879	31,882	45,996	7,427	18,007	13,795	8,452	579,300
1985	86,549	36,964	49,585	8,558	20,244	23,916	7,468	816,800

Source: Dataquest
September 1986

Six Year Overview

	COGS	GPM	R&D	SG&A	NIBT	NIAT	REV/EMP
	===	===	===	====	====	====	=======
Cad/Cam Companies							
1979	50%	50%	10%	22%	17%	10%	.058
1980	46%	54%	10%	24%	20%	12%	.060
1981	45%	55%	12%	28%	18%	11%	.075
1982	47%	53%	13%	28%	14%	8%	.083
1983	48%	52%	12%	27%	16%	10%	.084
1984	45%	55%	11%	27%	17%	10%	.098
1985	50%	50%	13%	27%	3%	1%	.108
Graphics Companies							
1979	50%	50%	7%	21%	16%	10%	.038
1980	53%	47%	7%	21%	14%	8%	.042
1981	53%	47%	7%	23%	13%	8%	.046
1982	56%	44%	7%	22%	11%	7%	.053
1983	60%	40%	7%	22%	8%	5%	.059
1984	59%	41%	34%	20%	10%	8%	.068
1985	31%	69%	38%	20%	7%	6%	.073
Computer Companies							
1979	42%	58%	6%	28%	19%	11%	.060
1980	43%	57%	6%	29%	19%	12%	.068
1981	45%	55%	6%	29%	18%	10%	.073
1982	43%	57%	9%	26%	20%	11%	.083
1983	44%	56%	8%	25%	20%	11%	.093
1984	34%	66%	10%	25%	20%	12%	.146
1985	37%	63%	10%	26%	17%	10%	.106
Other Companies							
1979	84%	16%	4%	9%	6%	2%	.064
1980	86%	14%	3%	10%	3%	2%	.073
1981	85%	15%	3%	9%	3%	2%	.099
1982	83%	17%	4%	10%	4%	3%	.101
1983	83%	17%	4%	10%	5%	3%	.109
1984	81%	19%	4%	11%	2%	4%	.109
1985	80%	20%	4%	10%	96%	3%	.120
Grand Total							
1979	47%	53%	6%	26%	18%	10%	.060
1980	49%	51%	6%	27%	17%	10%	.068
1981	51%	49%	6%	26%	16%	9%	.074
1982	49%	51%	8%	24%	18%	10%	.083
1983	49%	51%	8%	23%	18%	10%	.093
1984	41%	59%	10%	23%	18%	11%	.134
1985	43%	57%	10%	23%	28%	9%	.106

Source: Dataquest
September 1986

CAD/CAM Index Scoreboard

INTRODUCTION

The CAD/CAM Index Scoreboard is a five-year summary of annual financial data for publicly held companies that participate in the CAD/CAM industry.

Dataquest publishes the "CAD/CAM Index Scoreboard" so that clients can evaluate the CAD/CAM market from a financial perspective. In particular, clients can compare their own income statements with the summarized indices to determine how they are financially positioned in comparison with the industry and their competitors.

The same companies contained in the "CAD/CAM Index Scoreboard" are also reported on in our quarterly newsletter. The quarterly newsletter analyzes only revenue and net profit information, whereas the scoreboard analyzes income statement data in more detail. All data are for the company's fiscal quarter; unlike our forecast and market share reports, we do not present company data for the index in calendar form.

DEFINITION OF TERMS

So that our terms are understood in the context in which they are analyzed, this section defines their source or the method of calculation used. In most cases, we obtain data directly from annual reports. When this is not the case, we indicate so by stating the way in which we calculate the data.

- Revenue—money received by a company for the sale of products and services for its fiscal year, as reported by the company
- Cost of goods sold (COGS)—product manufacturing costs, as reported by the company
- Gross margin—gross profits calculated by subtracting the cost of goods sold from revenue
- R&D—expenses associated with research and development costs for products and services, as reported by the company
- SG&A—expenses associated with sales, marketing, general, and administrative costs, as reported by the company
- Operating income (OI)—income from operations, calculated by subtracting R&D and SG&A expenses from gross margin (Other income and income expenses are not included in this calculated figure, and therefore, this data may not match the data as reported by the company.)
- Net income after tax—net profit after taxes and other extraordinary items, as reported by the company

SCOREBOARD SUMMARY

Detailed data by year for each of the "CAD/CAM Index Scoreboard" segments and the companies constituting the segments are found in Tables 1 through 10. Tables 11 and 12 summarize all other tables. Figures 1 through 7 present the summary data in Tables 11 and 12 in graphic form.

Figure 1 shows how the five segments' income statements fared relative to one another.

SG&A expenses, on the average, were in the mid-to-high 20 percent range for most segments. The one exception is the EDA segment, with average SG&A expense of 43 percent of revenue. We believe that this reflects a combination of lower-than-expected revenue for some EDA companies and expense levels that were not adjusted quickly enough to compensate.

R&D expenses for the entire index were 11 percent on the average, although the EDA and terminal segments' expenses were more, at 16 and 19 percent, respectively.

COGS varied considerably from the index's average of 45 percent of revenue. The EDA segment had the lowest COGS percentage in 1986, at 39 percent of revenue. The terminal segment had the highest, at 55 percent.

The most profitable segments, measured by operating income as a percentage of revenue, are the computer manufacturers, with a 16 percent net profit margin, followed closely by CAD/CAM vendors at 11 percent. Profit margins for all other segments are less than 10 percent, with the EDA segment's disappointing 1 percent the lowest of all.

Table 1

CAD/CAM Index Scoreboard—1982
(Millions of Dollars/Actual Employees)

	Revenue	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Total Employees
Auto-Trol	44	28	16	8	17	(9)	(8)	564
Computervision	325	147	178	36	98	44	32	4,130
Intergraph	156	79	77	20	32	25	13	1,800
MacNeal-Schwendler	7	1	6	1	2	3	1	NA
Synercom	9	9	(0)	3	4	(7)	(7)	129
CAD/CAM Vendors	541	264	277	68	153	57	32	6,623
Daisy	5	1	3	2	2	0	0	86
Mentor	2	1	1	1	2	(2)	(2)	36
Silvar-Lisco	2	0	2	0	1	0	0	31
Valid	2	1	1	2	2	(3)	(2)	72
EDA Vendors	11	3	7	5	7	(5)	(4)	225
Control Data	4,340	2,040	2,300	325	693	1,282	155	56,005
Data General	806	457	348	85	228	36	25	15,210
Digital Equipment	3,881	2,188	1,693	350	759	585	417	67,100
Hewlett-Packard	4,180	1,967	2,213	424	1,122	667	383	68,000
IBM	34,364	13,688	20,676	3,042	9,578	8,056	4,409	364,796
Prime	436	186	250	37	145	69	45	5,311
Computer Manufacturers	48,007	20,526	27,481	4,262	12,524	10,694	5,434	576,422
Apollo	18	8	10	3	7	0	0	427
Workstation Manufacturers	18	8	10	3	7	0	0	427
Adage	26	15	10	2	5	3	2	400
Evans & Sutherland	54	26	27	5	8	15	10	775
Ramtek	46	23	23	5	12	6	3	NA
Terminal Manufacturers	126	65	61	12	25	24	14	1,175
All Companies	48,702	20,866	27,836	4,351	12,715	10,771	5,477	584,872

Source: Dataquest
October 1987

Table 2

CAD/CAM Index Scoreboard—1982
(Percentage of Revenue/Millions of Dollars)

	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Revenue/ Employee
Auto-Trol	63%	37%	18%	39%	-23%	-17%	.078
Computervision	45%	55%	11%	30%	14%	10%	.079
Intergraph	51%	49%	13%	21%	16%	8%	.086
MacNeal-Schwendler	14%	86%	14%	26%	36%	19%	NA
Synercom	100%	-0%	32%	39%	-71%	-77%	NA
CAD/CAM Vendors	49%	51%	13%	28%	11%	6%	.082
Daisy	27%	73%	35%	36%	2%	5%	.053
Mentor	52%	48%	60%	108%	-120%	-112%	.048
Silvar-Lisco	4%	96%	27%	47%	22%	13%	NA
Valid	40%	60%	67%	101%	-108%	-96%	.034
EDA Vendors	30%	70%	47%	66%	-43%	-38%	.047
Control Data	47%	53%	8%	16%	30%	4%	.077
Data General	57%	43%	11%	28%	5%	3%	.053
Digital Equipment	56%	44%	9%	20%	17%	11%	.058
Hewlett-Packard	47%	53%	10%	27%	16%	9%	.061
IBM	40%	60%	9%	28%	23%	13%	.094
Prime	43%	57%	9%	33%	16%	10%	.082
Computer Manufacturers	43%	57%	9%	26%	22%	11%	.083
Apollo	45%	56%	17%	38%	1%	2%	.042
Workstation Manufacturers	45%	56%	17%	38%	1%	2%	.042
Adage	60%	40%	7%	20%	13%	7%	.065
Evans & Sutherland	49%	51%	10%	14%	27%	18%	.069
Ramtek	50%	50%	11%	26%	13%	6%	NA
Terminal Manufacturers	52%	49%	10%	20%	19%	11%	.107
All Companies	43%	57%	9%	26%	22%	11%	.083

Source: Dataquest
October 1987

Table 3

CAD/CAM Index Scoreboard—1983
(Millions of Dollars/Actual Employees)

	Revenue	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Total Employees
Auto-Trol	54	30	24	8	16	(1)	3	600
Computervision	400	186	214	44	120	51	43	5,070
Intergraph	252	123	129	28	47	53	29	2,800
MacNeal-Schwendler	9	1	8	2	3	3	2	72
Synercom	10	7	2	3	3	(4)	(5)	167
CAD/CAM Vendors	725	348	377	85	190	102	73	8,709
Daisy	17	4	13	4	7	2	3	232
Mentor	26	15	11	3	9	(0)	(0)	192
Silvar-Lisco	4	0	4	1	2	0	0	59
Valid	16	6	10	2	7	1	2	176
Zycad	4	1	3	1	1	1	1	NA
EDA Vendors	64	24	39	12	26	2	3	657
Control Data	4,583	2,068	2,515	0	712	1,803	162	55,858
Data General	829	476	353	85	231	37	23	14,855
Digital Equipment	4,272	2,606	1,666	472	831	363	284	73,000
Hewlett-Packard	4,922	2,195	2,727	493	1,294	940	432	72,000
IBM	40,180	16,395	23,785	3,582	10,614	9,589	5,485	369,545
Prime	517	243	274	52	171	51	33	5,927
Computer Manufacturers	55,302	23,983	31,319	4,684	13,852	12,782	6,418	591,185
Apollo	81	32	49	10	24	14	13	1,107
Masscomp	3	2	1	2	2	(4)	(3)	132
Sun Microsystems	9	4	4	2	2	1	1	NA
Workstation Manufacturers	89	37	53	14	27	12	11	1,107
Adage	36	19	17	4	8	5	3	558
Evans & Sutherland	61	28	32	7	9	16	11	850
Ramtek	41	19	22	7	13	2	1	NA
Terminal Manufacturers	138	67	71	17	30	24	15	1,408
All Companies	56,317	24,459	31,859	4,812	14,125	12,922	6,520	603,066

Source: Dataquest
October 1987

Table 4

CAD/CAM Index Scoreboard—1983
(Percentage of Revenue/Millions of Dollars)

	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Revenue/ Employee
Auto-Trol	56%	44%	15%	30%	6%	6%	.090
Computervision	46%	54%	11%	30%	15%	11%	.079
Intergraph	49%	51%	11%	19%	21%	12%	.090
MacNeal-Schwendler	13%	87%	18%	37%	34%	19%	.128
Synercom	74%	26%	31%	36%	-42%	-47%	NA
CAD/CAM Vendors	48%	52%	12%	26%	14%	10%	.083
Daisy	23%	77%	23%	41%	12%	15%	.075
Mentor	56%	44%	11%	33%	-1%	-1%	.134
Silvar-Lisco	0%	100%	34%	55%	11%	5%	NA
Valid	36%	64%	13%	43%	9%	12%	.091
Zycad	27%	74%	31%	27%	15%	20%	NA
EDA Vendors	38%	62%	18%	40%	3%	4%	.097
Control Data	45%	55%	0%	16%	5%	4%	.082
Data General	58%	43%	10%	28%	5%	3%	.056
Digital Equipment	61%	39%	11%	19%	10%	7%	.059
Hewlett-Packard	45%	55%	10%	26%	19%	9%	.068
IBM	41%	59%	9%	26%	24%	14%	.109
Prime	47%	53%	10%	33%	10%	6%	.087
Computer Manufacturers	43%	57%	9%	25%	23%	12%	.094
Apollo	40%	60%	13%	30%	21%	16%	.073
Masscomp	70%	30%	78%	89%	-137%	-120%	NA
Sun Microsystems	52%	48%	22%	20%	7%	8%	NA
Workstation Manufacturers	41%	59%	16%	30%	14%	13%	.081
Adage	54%	46%	10%	21%	16%	9%	.064
Evans & Sutherland	47%	53%	11%	16%	27%	18%	.071
Ramtek	47%	53%	17%	32%	4%	2%	NA
Terminal Manufacturers	49%	52%	13%	22%	17%	11%	.098
All Companies	43%	57%	9%	25%	23%	12%	.093

Source: Dataquest
October 1987

Table 5

CAD/CAM Index Scoreboard—1984
(Millions of Dollars/Actual Employees)

	Revenue	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Total Employees
Auto-Trol	69	36	33	8	21	(1)	1	666
Autodesk	1	0	1	0	1	0	0	NA
Computervision	556	256	301	61	166	51	48	6,530
Intergraph	404	191	213	37	67	109	63	3,700
MacNeal-Schwendler	12	3	9	2	3	3	1	92
Synercom	9	6	3	4	5	(5)	(5)	175
CAD/CAM Vendors	1,051	492	560	112	262	157	108	11,163
Cadnetix	4	1	3	2	3	(2)	(2)	NA
Daisy	69	17	52	11	24	2	11	565
ECAD	6	0	6	2	2	2	1	NA
Mentor	88	47	41	8	24	(0)	8	528
Silvar-Lisco	11	1	11	3	6	1	1	154
Valid	48	16	32	5	18	0	6	375
Zycad	22	4	18	4	7	6	5	NA
EDA Vendors	226	82	144	31	78	3	25	1,622
Control Data	3,692	1,597	2,095	417	743	1,803	(19)	54,123
Data General	1,161	659	502	102	298	37	80	17,677
Digital Equipment	5,584	3,380	2,205	631	1,180	363	329	84,000
Hewlett-Packard	6,044	2,865	3,179	592	1,727	940	665	85,000
IBM	45,937	18,919	27,018	4,200	11,587	11,231	6,582	394,930
Prime	643	302	341	64	204	51	60	7,348
Computer Manufacturers	63,061	27,721	35,340	6,005	15,738	14,424	7,696	643,078
Apollo	216	91	125	26	60	14	24	3,021
Masscomp	22	12	10	4	7	(1)	(1)	357
Silicon Graphics	5	3	2	4	5	(7)	(7)	NA
Sun Microsystems	39	21	18	5	9	4	3	NA
Workstation Manufacturers	260	116	144	35	73	11	20	3,021
Adage	49	27	22	5	11	5	4	590
Evans & Sutherland	70	38	32	10	12	16	7	915
Ramtek	35	24	11	7	16	(13)	(15)	NA
Terminal Manufacturers	154	89	65	23	39	9	(4)	1,505
All Companies	64,753	28,500	36,252	6,207	16,190	14,604	7,846	660,389

Source: Dataquest
October 1987

Table 6

CAD/CAM Index Scoreboard—1984
(Percentage of Revenue/Millions of Dollars)

	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Revenue/ Employee
Auto-Trol	52%	48%	12%	30%	4%	2%	.103
Autodesk	19%	81%	17%	53%	10%	10%	NA
Computervision	46%	54%	11%	30%	13%	9%	.085
Intergraph	47%	53%	9%	17%	27%	16%	.109
MacNeal-Schwendler	24%	76%	15%	28%	36%	12%	.128
Synercom	62%	38%	39%	53%	-54%	-56%	NA
CAD/CAM Vendors	47%	53%	11%	25%	15%	10%	.094
Cadnetix	28%	72%	52%	73%	-54%	-47%	NA
Daisy	25%	75%	16%	35%	28%	16%	.122
ECAD	0%	100%	29%	43%	28%	18%	NA
Mentor	53%	47%	9%	27%	16%	10%	.166
Silvar-Lisco	5%	95%	30%	55%	11%	6%	.072
Valid	34%	67%	11%	38%	22%	13%	.129
Zycad	18%	82%	20%	34%	28%	23%	NA
EDA Vendors	36%	64%	14%	35%	1%	11%	.139
Control Data	43%	57%	11%	20%	-1%	-1%	.068
Data General	57%	43%	9%	26%	9%	7%	.066
Digital Equipment	61%	40%	11%	21%	7%	6%	.066
Hewlett-Packard	47%	53%	10%	29%	14%	11%	.071
IBM	41%	59%	9%	25%	24%	14%	.116
Prime	47%	53%	10%	32%	11%	9%	.087
Computer Manufacturers	44%	56%	10%	25%	23%	12%	.098
Apollo	42%	58%	12%	28%	19%	11%	.071
Masscomp	53%	47%	19%	33%	-6%	-5%	.061
Silicon Graphics	59%	42%	82%	85%	-125%	-123%	NA
Sun Microsystems	55%	45%	12%	23%	10%	7%	NA
Workstation Manufacturers	45%	56%	13%	28%	4%	8%	.086
Adage	55%	45%	11%	21%	16%	9%	.084
Evans & Sutherland	55%	45%	15%	17%	17%	10%	.077
Ramtek	69%	31%	22%	46%	-37%	-44%	NA
Terminal Manufacturers	58%	42%	15%	25%	6%	-2%	.102
All Companies	44%	56%	10%	25%	23%	12%	.098

Source: Dataquest
October 1987

Table 7

CAD/CAM Index Scoreboard—1985
(Millions of Dollars/Actual Employees)

	Revenue	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Total Employees
Auto-Trol	65	39	26	10	22	(6)	(12)	672
Autodesk	10	2	8	2	4	2	2	214
Computervision	441	287	154	62	163	(70)	(81)	4,400
Intergraph	526	260	266	51	100	116	68	5,100
MacNeal-Schwendler	15	3	12	2	5	5	3	92
PDA Engineering	15	8	6	2	3	2	2	120
Synercom	17	7	10	3	5	2	2	162
CAD/CAM Vendors	1,090	606	483	131	301	51	(17)	10,760
Cadnetix	14	3	11	3	7	0	1	260
Daisy	123	29	93	22	41	31	21	923
ECAD	12	0	12	4	7	2	1	NA
Mentor	137	66	71	15	49	8	8	777
Silvar-Lisco	16	1	15	6	9	(1)	(0)	211
Valid	56	18	38	9	28	2	2	424
Zycad	29	7	22	9	15	(2)	(0)	NA
EDA Vendors	357	117	240	58	141	41	33	2,595
Control Data	3,680	1,597	2,083	438	753	892	(528)	44,308
Data General	1,238	727	511	128	347	35	24	16,535
Digital Equipment	6,686	4,088	2,599	717	1,432	450	447	89,000
Hewlett-Packard	6,505	3,166	3,339	685	1,896	758	489	84,000
IBM	50,056	18,666	31,390	4,723	13,000	13,667	6,555	405,535
Prime	770	358	411	82	252	78	58	8,115
Computer Manufacturers	68,935	28,602	40,333	6,774	17,680	15,880	7,045	647,493
Apollo	296	158	137	42	89	7	(2)	3,275
Masscomp	45	23	22	7	16	(1)	1	540
Silicon Graphics	22	12	10	5	10	(5)	(5)	NA
Sun Microsystems	115	62	54	15	24	14	9	1,223
Workstation Manufacturers	432	232	201	62	123	16	2	4,498
Adage	43	25	17	6	10	1	2	592
Evans & Sutherland	80	40	40	17	9	14	6	1,000
Ramtek	44	25	19	6	13	(0)	(2)	NA
Terminal Manufacturers	166	90	77	30	32	15	6	1,592
All Companies	70,980	29,646	41,334	7,054	18,277	16,003	7,069	666,938

Source: Dataquest
October 1987

Table 8

CAD/CAM Index Scoreboard—1985
(Percentage of Revenue/Millions of Dollars)

	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Revenue/ Employee
Auto-Trol	60%	40%	15%	34%	-15%	-18%	.097
Autodesk	15%	85%	17%	44%	29%	17%	.046
Computervision	65%	35%	14%	37%	-29%	-18%	.100
Intergraph	49%	51%	10%	19%	22%	13%	.103
MacNeal-Schwendler	22%	79%	14%	30%	38%	21%	.167
PDA Engineering	56%	44%	13%	18%	16%	11%	.122
Synercom	40%	60%	19%	30%	10%	10%	.105
CAD/CAM Vendors	56%	44%	12%	28%	5%	-2%	.101
Cadnetix	24%	76%	24%	50%	6%	6%	.054
Daisy	24%	76%	18%	33%	29%	17%	.133
ECAD	0%	100%	30%	56%	14%	10%	NA
Mentor	48%	52%	11%	36%	9%	6%	.176
Silvar-Lisco	6%	94%	38%	60%	-2%	-3%	.074
Valid	31%	69%	15%	51%	3%	3%	.132
Zycad	25%	76%	32%	51%	-8%	-1%	NA
EDA Vendors	33%	67%	16%	40%	12%	9%	.138
Control Data	43%	57%	12%	21%	-13%	-14%	.083
Data General	59%	41%	10%	28%	3%	2%	.075
Digital Equipment	61%	39%	11%	21%	6%	7%	.075
Hewlett-Packard	49%	51%	11%	29%	12%	8%	.077
IBM	37%	63%	9%	26%	27%	13%	.123
Prime	47%	53%	11%	33%	10%	8%	.095
Computer Manufacturers	42%	59%	10%	26%	23%	10%	.106
Apollo	54%	47%	14%	30%	-5%	-1%	.090
Masscomp	51%	49%	16%	35%	-2%	2%	.084
Silicon Graphics	54%	46%	23%	45%	-22%	-22%	NA
Sun Microsystems	54%	47%	13%	21%	12%	7%	.094
Workstation Manufacturers	54%	46%	14%	28%	4%	1%	.096
Adage	59%	41%	14%	24%	5%	4%	.072
Evans & Sutherland	50%	50%	22%	11%	13%	8%	.080
Ramtek	56%	44%	14%	30%	-1%	-5%	NA
Terminal Manufacturers	54%	46%	18%	19%	9%	3%	.104
All Companies	42%	58%	10%	26%	23%	10%	.106

Source: Dataquest
October 1987

Table 9

CAD/CAM Index Scoreboard—1986
(Millions of Dollars/Actual Employees)

	Revenue	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Total Employees
Auto-Trol	62	34	28	9	21	(2)	(7)	631
Autodesk	30	5	25	2	11	12	7	214
Computervision	495	299	196	47	144	6	(6)	4,775
Intergraph	606	300	305	58	134	114	70	5,700
MacNeal-Schwendler	21	4	17	3	6	8	3	.130
PDA Engineering	17	9	9	3	5	1	1	170
Synercom	17	6	11	3	7	1	2	178
CAD/CAM Vendors	1,248	657	591	124	327	140	70	11,798
Cadnetix	33	7	26	5	16	5	5	350
Daisy	107	35	73	25	58	(11)	(1)	883
ECAD	17	0	17	5	10	2	1	158
Mentor	174	96	77	17	48	12	11	909
Silvar-Lisco	20	1	19	7	11	1	0	266
Valid	61	22	39	7	36	(5)	(7)	408
Zycad	24	12	12	10	15	(13)	(18)	196
EDA Vendors	410	161	249	66	178	5	10	2,974
Control Data	3,347	2,264	1,083	403	683	(4)	(265)	34,409
Data General	1,268	738	530	143	366	21	(29)	15,565
Digital Equipment	7,590	4,282	3,308	814	1,665	829	617	95,000
Hewlett-Packard	7,102	3,353	3,749	824	2,145	780	516	82,000
IBM	51,250	20,748	30,502	5,221	15,464	9,817	4,789	403,508
Prime	860	407	453	92	298	63	47	8,350
Computer Manufacturers	71,417	31,792	39,625	7,497	20,621	11,506	5,676	638,832
Apollo	392	210	182	45	116	21	9	3,577
Masscomp	51	27	24	7	19	(2)	(1)	525
Silicon Graphics	42	18	24	7	15	2	2	331
Sun Microsystems	210	102	108	31	57	21	12	2,031
Workstation Manufacturers	643	330	313	83	188	43	23	5,939
Adage	37	26	11	7	10	(6)	(5)	425
Evans & Sutherland	109	51	58	20	19	18	11	1,171
Ramtek	31	20	11	6	13	(8)	(4)	290
Terminal Manufacturers	177	98	80	33	42	4	2	1,886
All Companies	73,896	33,038	40,858	7,803	21,357	11,698	5,781	661,429

Source: Dataquest
October 1987

Table 10

CAD/CAM Index Scoreboard—1986
(Percentage of Revenue/Millions of Dollars)

	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Revenue/ Employee
	=======	======	===	====	=========	=========	========
Auto-Trol	55%	45%	15%	33%	-3%	-11%	.099
Autodesk	16%	85%	6%	37%	42%	22%	.138
Computervision	60%	40%	9%	29%	1%	-1%	.104
Intergraph	50%	50%	10%	22%	19%	12%	.106
MacNeal-Schwendler	21%	79%	14%	28%	37%	12%	.162
PDA Engineering	51%	49%	15%	27%	8%	8%	.103
Synercom	35%	65%	16%	43%	6%	10%	.097
CAD/CAM Vendors	53%	47%	10%	26%	11%	6%	.106
Cadnetix	21%	79%	16%	48%	15%	16%	.093
Daisy	32%	68%	24%	54%	-10%	-1%	.121
ECAD	0%	100%	27%	59%	14%	9%	.105
Mentor	56%	44%	10%	28%	7%	6%	.191
Silvar-Lisco	5%	95%	37%	55%	3%	2%	.073
Valid	37%	63%	12%	59%	-8%	-12%	.149
Zycad	50%	50%	41%	63%	-54%	-74%	.123
EDA Vendors	39%	61%	16%	43%	1%	2%	.138
Control Data	68%	32%	12%	20%	-0%	-8%	.097
Data General	58%	42%	11%	29%	2%	-2%	.081
Digital Equipment	56%	44%	11%	22%	11%	8%	.080
Hewlett-Packard	47%	53%	12%	30%	11%	7%	.087
IBM	41%	60%	10%	30%	19%	9%	.127
Prime	47%	53%	11%	35%	7%	6%	.103
Computer Manufacturers	45%	56%	11%	29%	16%	8%	.112
Apollo	54%	46%	11%	30%	5%	2%	.110
Masscomp	53%	47%	15%	37%	-4%	-3%	.097
Silicon Graphics	43%	57%	17%	36%	4%	5%	.125
Sun Microsystems	49%	52%	15%	27%	10%	6%	.103
Workstation Manufacturers	51%	49%	13%	29%	7%	4%	.108
Adage	70%	30%	19%	26%	-15%	-15%	.087
Evans & Sutherland	47%	53%	19%	18%	17%	10%	.093
Ramtek	65%	35%	20%	42%	-27%	-12%	.107
Terminal Manufacturers	55%	45%	19%	24%	2%	1%	.094
All Companies	45%	55%	11%	29%	16%	8%	.112

Source: Dataquest
October 1987

Table 11

CAD/CAM Index Scoreboard—Five-Year Overview (Millions of Dollars/Actual Employees)

	Revenue	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Total Employees
CAD/CAM Vendors								
1982	541	264	277	68	153	57	32	6,623
1983	725	348	377	85	190	102	73	8,709
1984	1,051	492	560	112	262	157	108	11,163
1985	1,090	606	483	131	301	51	(17)	10,760
1986	1,248	657	591	124	327	140	70	11,798
EDA Vendors								
1982	11	3	7	5	7	(5)	(4)	225
1983	64	24	39	12	26	2	3	657
1984	226	82	144	31	78	3	25	1,622
1985	357	117	240	58	141	41	33	2,595
1986	410	161	249	66	178	5	10	2,974
Computer Manufacturers								
1982	48,007	20,526	27,481	4,262	12,524	10,694	5,434	576,422
1983	55,302	23,983	31,319	4,684	13,852	12,782	6,418	591,185
1984	63,061	27,721	35,340	6,005	15,738	14,424	7,696	643,078
1985	68,935	28,602	40,333	6,774	17,680	15,880	7,045	647,493
1986	71,417	31,792	39,625	7,497	20,621	11,506	5,676	638,832
Workstation Manufacturers								
1982	18	8	10	3	7	0	0	427
1983	89	37	53	14	27	12	11	1,107
1984	260	116	144	35	73	11	20	3,021
1985	432	232	201	62	123	16	2	4,498
1986	643	330	313	83	188	43	23	5,939
Terminal Manufacturers								
1982	126	65	61	12	25	24	14	1,175
1983	138	67	71	17	30	24	15	1,408
1984	154	89	65	23	39	9	(4)	1,505
1985	166	90	77	30	32	15	6	1,592
1986	177	98	80	33	42	4	2	1,886
All Companies								
1982	48,702	20,866	27,836	4,351	12,715	10,771	5,477	584,872
1983	56,317	24,459	31,859	4,812	14,125	12,922	6,520	603,066
1984	64,753	28,500	36,252	6,207	16,190	14,604	7,846	660,389
1985	70,980	29,646	41,334	7,054	18,277	16,003	7,069	666,938
1986	73,896	33,038	40,858	7,803	21,357	11,698	5,781	661,429

Source: Dataquest
October 1987

Table 12

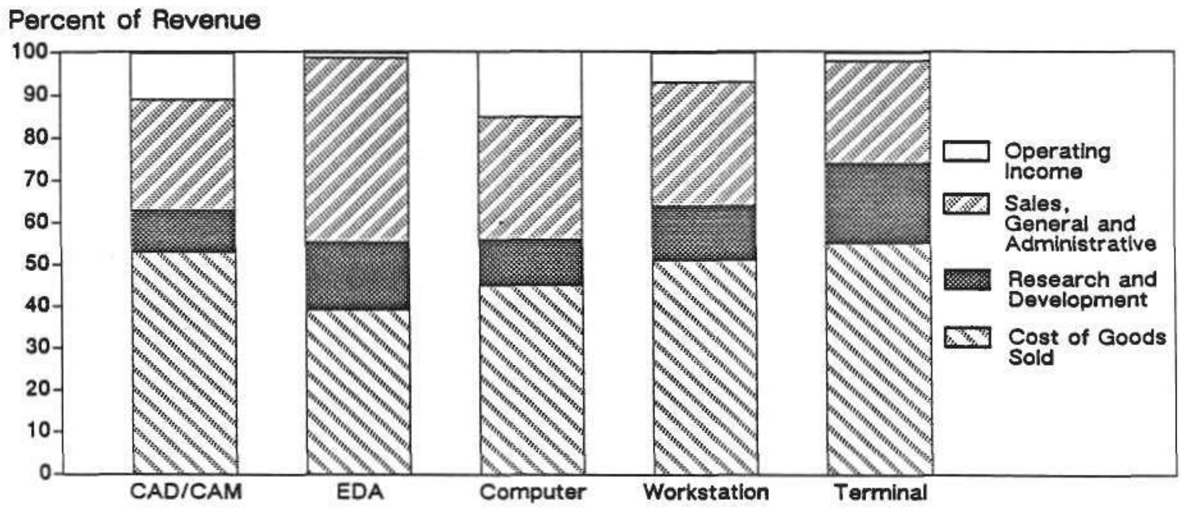
CAD/CAM Index Scoreboard—Five-Year Overview
(Percentage of Revenue/Millions of Dollars)

	Cost of Goods	Gross Margin	R&D	SG&A	Operating Income	Net Income After Tax	Revenue/ Employee
CAD/CAM Companies							
1982	49%	51%	13%	28%	10%	6%	.082
1983	48%	52%	12%	26%	14%	10%	.083
1984	47%	53%	11%	25%	15%	10%	.094
1985	56%	44%	12%	28%	5%	-2%	.101
1986	53%	47%	10%	26%	11%	6%	.106
EDA Vendors							
1982	30%	70%	47%	66%	-43%	-38%	.047
1983	38%	62%	18%	40%	3%	4%	.097
1984	36%	64%	14%	34%	1%	11%	.139
1985	33%	67%	16%	40%	12%	9%	.138
1986	39%	61%	16%	43%	1%	2%	.138
Computer Manufacturers							
1982	43%	57%	9%	26%	22%	11%	.083
1983	43%	57%	8%	25%	23%	12%	.094
1984	44%	56%	10%	25%	23%	12%	.098
1985	41%	59%	10%	26%	23%	10%	.106
1986	45%	55%	10%	29%	16%	8%	.112
Workstation Manufacturers							
1982	44%	56%	17%	38%	1%	2%	.042
1983	41%	59%	16%	30%	14%	13%	.081
1984	44%	56%	13%	28%	4%	8%	.086
1985	54%	46%	14%	28%	4%	1%	.096
1986	51%	49%	13%	29%	7%	4%	.108
Terminal Manufacturers							
1982	52%	48%	10%	20%	19%	11%	.107
1983	48%	52%	13%	22%	17%	11%	.098
1984	58%	42%	15%	25%	6%	-2%	.102
1985	54%	46%	18%	19%	9%	3%	.104
1986	55%	45%	19%	24%	2%	1%	.094
All Companies							
1982	43%	57%	9%	26%	22%	11%	.083
1983	43%	57%	9%	25%	23%	12%	.093
1984	44%	56%	10%	25%	23%	12%	.098
1985	42%	58%	10%	26%	23%	10%	.106
1986	45%	55%	11%	29%	16%	8%	.112

Source: Dataquest
October 1987

Figure 1

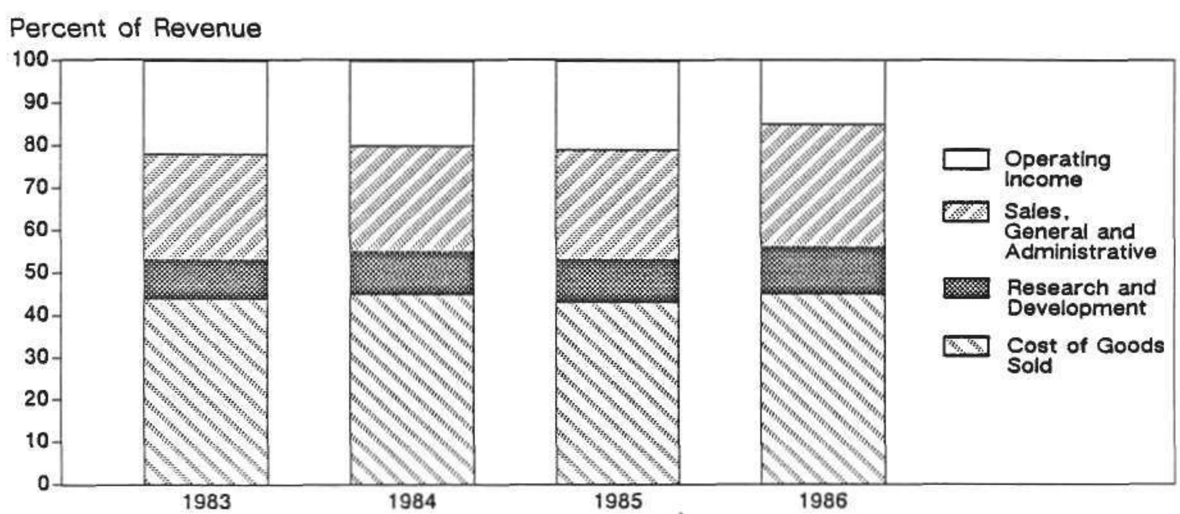
CAD/CAM Index Scoreboard
1986 Summary



Source: Dataquest
October 1987

Figure 2

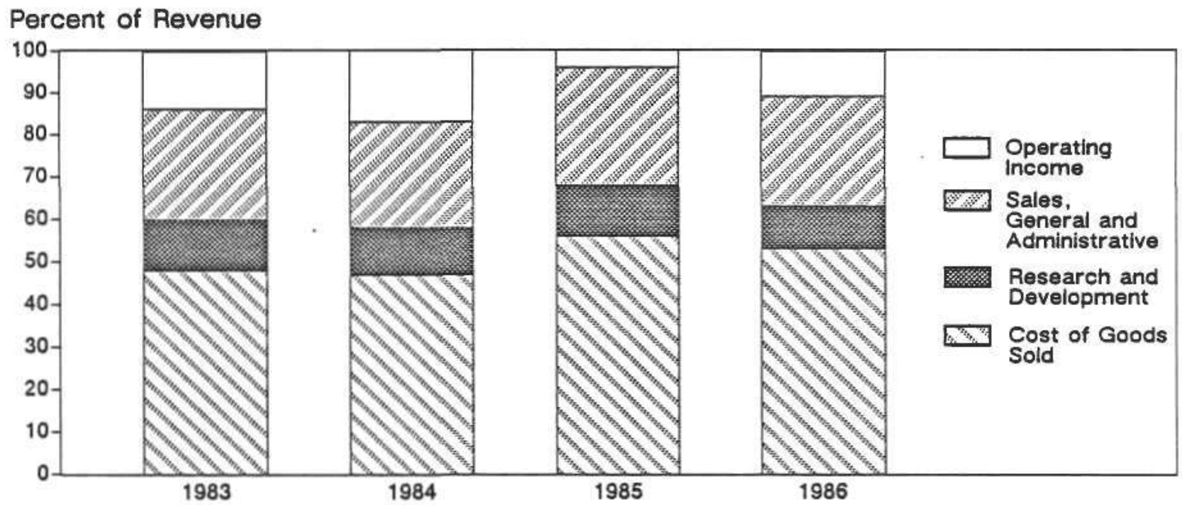
CAD/CAM Index Scoreboard
All Companies



Source: Dataquest
October 1987

Figure 3

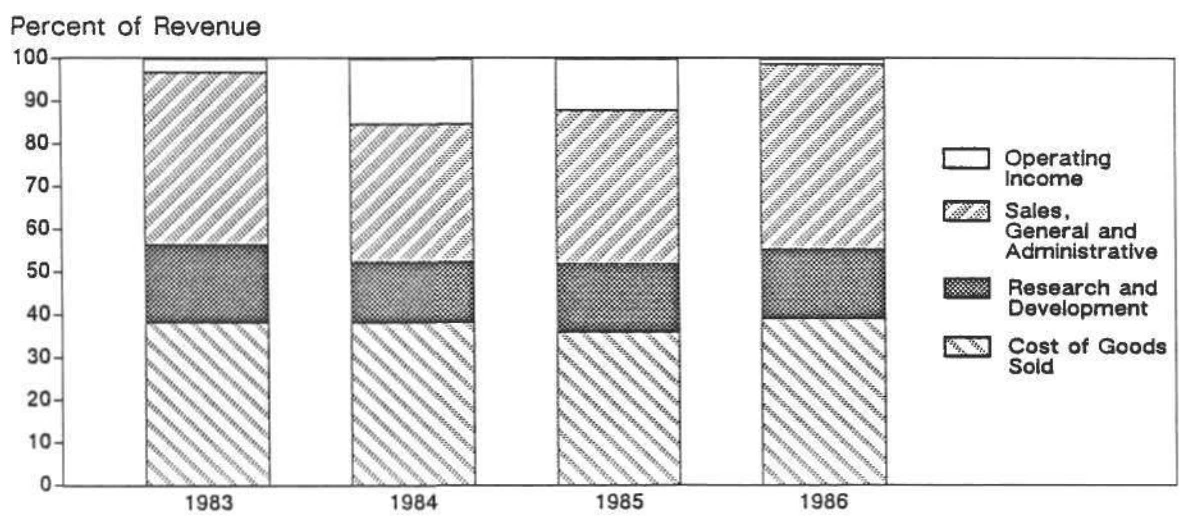
CAD/CAM Index Scoreboard
CAD/CAM Segment



Source: Dataquest
October 1987

Figure 4

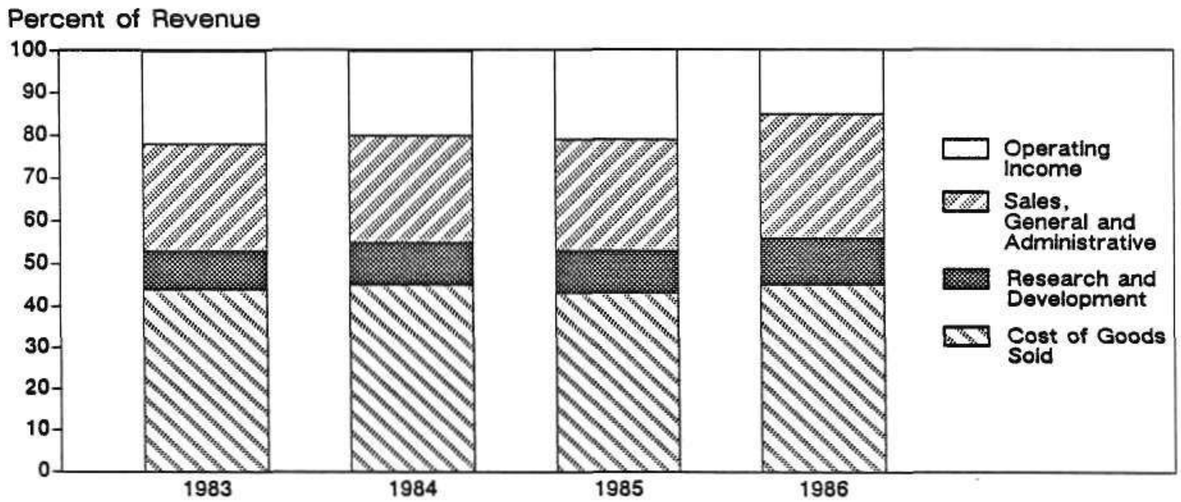
CAD/CAM Index Scoreboard
EDA Segment



Source: Dataquest
October 1987

Figure 5

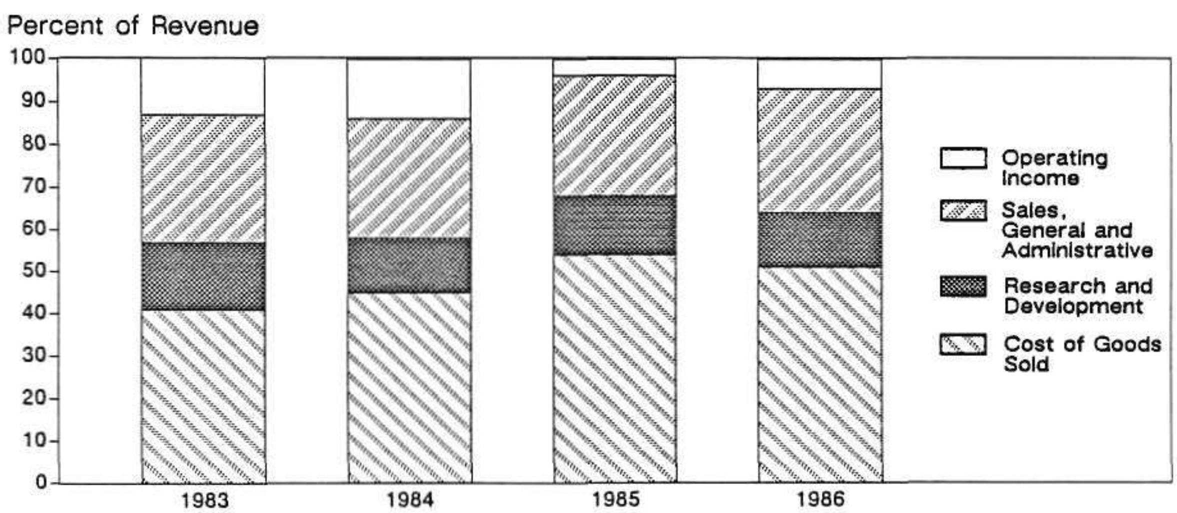
CAD/CAM Index Scoreboard
Computer Segment



Source: Dataquest
October 1987

Figure 6

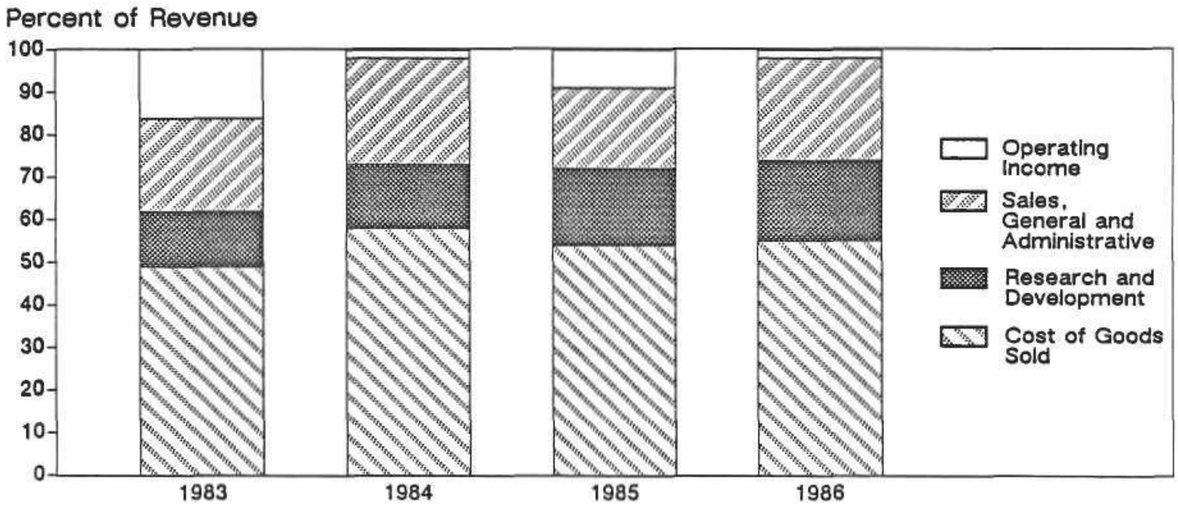
CAD/CAM Index Scoreboard
Workstation Segment



Source: Dataquest
October 1987

Figure 7
CAD/CAM Index Scoreboard

Terminal Segment



Source: Dataquest
October 1987

Adage, Inc.

Adage, Inc.

Adage, Inc.
One Fortune Drive
Billerica, Massachusetts 01821
Telephone: (617) 667-7070
(Millions of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF APRIL 1

	1981	1982	1983	1984	1985	CAGR 1981-1985
BALANCE SHEET DATA						
Working Capital	$ 3.3	$10.3	$27.7	$31.6	$31.8	75.6%
Long-Term Debt	$ 2.6	$ 1.1	$ 1.5	$ 2.5	$ 3.5	7.6%
Shareholders' Equity	$ 3.2	$12.0	$37.3	$42.1	$43.9	93.2%
After-Tax Return on Average Equity (%)	31.0%	24.7%	12.5%	10.8%	3.6%	
OPERATING PERFORMANCE*						
Revenue	$15.9	$25.8	$35.8	$49.4	$42.7	28.0%
U.S. Revenue	$13.3	$20.7	$30.4	$40.5	$37.7	29.9%
Non-U.S. Revenue	$ 2.7	$ 5.1	$ 5.4	$ 8.9	$ 5.0	17.2%
Cost of Goods Sold	$ 9.5	$15.4	$19.2	$27.0	$25.2	27.5%
Gross Margin	$ 6.4	$10.4	$16.6	$22.4	$17.5	28.7%
Expenses	$ 4.3	$ 7.0	$11.1	$16.0	$16.2	39.2%
R&D Expense	$ 1.1	$ 1.9	$ 3.6	$ 5.5	$ 6.0	51.6%
SG&A Expense	$ 3.2	$ 5.0	$ 7.5	$10.5	$10.2	33.8%
Operating Income	$ 2.1	$ 3.4	$ 5.5	$ 6.4	$ 1.3	(11.1%)
Interest Expense	($ 0.5)	($ 0.3)	($ 0.3)	($ 0.2)	($ 0.3)	(7.6%)
Interest Income	$ 0.6	$ 0.4	$ 0.6	$ 1.6	$ 1.4	24.5%
Net Other Expense	$ 0.0	$ 0.0	$ 0.0	$ 0.0	($ 0.1)	N/M
Income Before Tax	$ 1.6	$ 3.6	$ 5.8	$ 7.9	$ 2.2	8.5%
NOTE: Pretax Margin	10.0%	13.8%	16.2%	16.0%	5.2%	
Taxes	$ 0.8	$ 1.7	$ 2.7	$ 3.6	$ 0.7	(3.1%)
NOTE: Effective Tax Rate	47.3%	47.1%	46.7%	45.6%	30.1%	
Net Income After Tax	$ 0.8	$ 1.9	$ 3.1	$ 4.3	$ 1.5	16.4%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	2.4	2.9	3.7	4.7	4.7	18.9%
Per Share Data						
Earnings	$ 0.36	$ 0.64	$ 0.83	$ 0.92	$ 0.33	(2.2%)
Dividends	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	N/M
Book Value	$ 1.34	$ 4.09	$10.09	$ 8.96	$ 9.33	62.4%
Price Range (Low)	N/A	N/A	N/A	N/A	N/A	
(High)	N/A	N/A	N/A	N/A	N/A	
TOTAL EMPLOYEES	311	400	558	590	592	17.5%
Revenue per Employee	$ 0.1	$ 0.1	$ 0.1	$ 0.1	$ 0.1	9.0%

N/A = Not Available
N/M = Not Meaningful
*Totals may not add due to rounding

Source: Adage, Inc.,
Annual Reports &
Forms 10K
DATAQUEST

Adage, Inc.

Adage, Inc.
One Fortune Drive
Billerica, Massachusetts 01821
Telephone: (617) 667-7070
(Millions of Dollars Except Per Share Data)

LINE ITEMS AS A PERCENT OF REVENUE

	1981	1982	1983	1984	1985
OPERATING PERFORMANCE*					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
U.S Revenue	83.3%	80.2%	85.0%	82.0%	88.3%
Non-U.S. Revenue	16.7%	19.8%	15.0%	18.0%	11.7%
Cost of Goods Sold	60.0%	59.8%	53.5%	54.6%	59.1%
Gross Margin	40.0%	40.2%	46.5%	45.4%	40.9%
Expenses	27.1%	26.9%	31.1%	32.3%	37.9%
R&D Expense	7.2%	7.4%	10.1%	11.1%	14.1%
SG&A Expense	19.9%	19.5%	20.9%	21.3%	23.8%
Other Expense	0.0%	0.0%	0.0%	0.0%	0.0%
Operating Income	12.9%	13.3%	15.4%	13.1%	3.0%
Interest Expense	(2.9%)	(1.2%)	(0.8%)	(0.4%)	(0.8%)
Interest Income	3.7%	1.7%	1.6%	3.3%	3.3%
Other Income (Expense)	0.0%	0.0%	0.0%	0.0%	(0.3%)
Income Before Tax	10.0%	13.8%	16.2%	16.0%	5.2%
Taxes	4.7%	6.5%	7.6%	7.3%	1.6%
Net Income After Tax	5.3%	7.3%	8.6%	8.7%	3.6%

*Totals may not add due to rounding

Source: DATAQUEST

Adage, Inc.

THE COMPANY

Background

Adage, Inc., designs, manufactures, markets, and services interactive computer graphics terminals and systems as well as CAD/CAM workstations. The Company was incorporated in Massachusetts in 1957 and entered the graphics field in 1968.

Highlights

- September 1985--Adage unveiled its first series of standalone workstation products, the Adage 6500. This product line couples the Adage Series 6000 with the MicroVAX II from Digital Equipment Corporation.

- July 1985--The Company introduced the Model 3140 display system for simulation applications.

- January 1985--Adage introduced the Adage 6080, a plug-compatible version of the IBM 5080 Graphics System.

- July 1984--The Company announced the CADstation 2/50, a standalone design/drafting system specifically tailored for CADAM users.

Organization

Adage's executive offices are located in Billerica, Massachusetts. European headquarters are located in Wiesbaden, West Germany. The Company currently has over 50 sales and service offices, and it employs more than 592 people worldwide.

Marketing and Sales

Adage's domestic sales offices are located in the following states:

California	Louisiana	New York
Connecticut	Maryland	North Carolina
Florida	Massachusetts	Ohio
Georgia	Michigan	Pennsylvania
Illinois	Minnesota	Tennessee
Indiana	Missouri	Texas
Kansas	New Jersey	Washington

The Company's U.S. sales organization is divided into four regions, with headquarters as follows:

- Eastern Region--Rockville, Maryland
- Central Region--St. Louis, Missouri
- Western Region--Newport Beach, California
- European Region--Wiesbaden, West Germany

International Sales

In Western Europe, Adage's sales and customer service operations are managed by its wholly owned German subsidiary, Adage GmbH, located in Wiesbaden, West Germany. Other wholly owned subsidiaries are located in the United Kingdom and Italy. The Company has sales and service offices in Italy, the Netherlands, the United Kingdom, and West Germany. The Company's European sales force is augmented by independent sales representatives.

Adage markets its products in Japan through distributor agreements with Nippon Univac Kaisha, Ltd., and Kanematsu-Gosho (U.S.A.) Inc. Each distributor is responsible for a different portion of Adage's product line.

Historically, Adage has marketed some of its equipment through a third-party leasing program that requires the purchase of Adage's equipment by the lessor. During the past three years, the equipment sold through this program has generated less than 5 percent total revenues.

Approximately 80 percent of Adage's 1985 revenues were derived from the sale of products. Non-U.S. revenues accounted for approximately 11 percent of Adage's total 1985 revenues. Adage employs more than 250 people in sales and service worldwide.

Research and Development

The Company has shifted its product development focus from vector refresh products to a concentration in raster graphics. Adage develops high-performance functionality for applications such as solids modeling, shading, and model transformation in hardware and software. There is a continuing effort to include local intelligence in the workstations.

Adage spent $6 million (14 percent of its revenues) on product development in fiscal 1985, compared to $5.5 million (or 11 percent of revenues) in 1984.

Support

The maintenance and support of products generate the remaining 20 percent of the Company's revenues. Approximately 26 percent of Adage's personnel (155 employees) are engaged in providing customer service. These employees provide installation, warranty service, preventive and remedial service, and general assistance to customers. The Company's distributors provide equivalent service capabilities for their customers, using personnel trained by Adage.

Adage offers service contracts that make complete maintenance service available for a fixed monthly charge. Per-call and on-site service are also available.

Manufacturing

The Company's 65,000-square-foot manufacturing plant is located at corporate headquarters in Billerica, Massachusetts.

Due to the increased costs of certain electronic components and product price reductions, cost of goods sold rose to approximately 59 percent of revenues, or $25.2 million for fiscal 1985, reflecting a decrease in gross margins of 7 percent from $27.0 million for fiscal 1984.

MAJOR HISTORICAL MILESTONES

The following is a reverse chronological list of the events that have shaped Adage's history as a CAD/CAM and graphics company, up to its most recent fiscal year:

- 1984--Introduced OCEAN, new proprietary graphics engine
- 1984--Unveiled CADstation TM 2/50 System
- 1984--Signed a product agreement with Andra Systems
- 1984--Adage GmbH relocated to Wiesbaden, West Germany
- 1983--Introduced the 4250 Color Raster Graphics Workstation

Adage, Inc.

- 1982--Adage Ltd. and Adage SrL formed in England and Italy, respectively
- 1982--Acquired Ikonas Graphics Systems
- 1980--Headquarters relocated to Billerica, Massachusetts
- 1979--Adage GmbH formed in West Germany
- 1978--Introduced the 4000 Series of Vector Refresh Workstations
- 1976--Entered the IBM plug-compatible market with the GT/2250 workstation
- 1967--Dedicated Company strategy to interactive computer graphics systems
- 1957--Founded as a manufacturer of analog-to-digital converters

PRODUCTS

Graphics Products

The Adage graphics product line consists of the Adage 3000 color raster display system and the Adage 4000 Series vector refresh group. Adage manufactures, sells, and services its entire product line. For more information, please refer to Table 1.

Table 1

Adage, Inc.
GRAPHICS PRODUCTS

Terminals	Type	Number of Colors	Resolution
Adage 6500	Standalone	256	1024 x 1024
Adage 6080	Host-dependent	256	1024 x 1024
Adage 4250	Host-dependent	256	1280 x 1024
Adage 3000	Host-dependent	16 million	1024 x 1024
Adage 4370	Host-dependent	1	1024 x 1024

Source: DATAQUEST

CAD/CAM PRODUCTS

The Adage CADstation 2/50 is a standalone raster graphics system that operates similarly to a CADAM system. Software includes design and drafting capabilities similarly to those of the CADAM CAD-Only module, as well as host-resident software for CADstation 2/50 access to CADAM data base via GIM (Geometry Interface Module).

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Adage, Inc.

Adage, Inc.
One Fortune Drive
Billerica, Massachusetts 01821
Telephone: (617) 667-7070
(Millions of Dollars Except Per Share Data)

Balance Sheet (March 31, 1984)

	1980	1981	1982	1983	1984
Working Capital	$ 2.96	$ 3.34	$10,259	$27,662	$31,625
Long-Term Debt	$ 1.90	$ 2.57	$ 1.07	$ 1.48	$ 2.53
Shareholders' Equity	$ 2.30	$ 3.15	$ 12.02	$ 37.33	$ 42.12
After-Tax Return on Average Equity (%)	23	27	25	13	11

Operating Performance (Fiscal Year Ending March 31, 1984)

	1980	1981	1982	1983	1984
Revenue	$10.28	$15.90	$ 25.80	$ 35.80	$ 49.40
U.S. Revenue*	$ 9.03	$ 3.25	$ 20.62	$ 30.42	$ 40.50
Non-U.S. Revenue*	$ 1.24	$ 2.65	$ 5.16	$ 5.37	$ 8.90
Cost of Revenue	$ 0.89	$ 1.14	$ 15.42	$ 19.17	$ 26.98
R&D Expense	$ 5.88	$ 9.54	$ 1.92	$ 3.63	$ 5.46
SG&A Expense	$ 2.1	$ 1.21	$ 5.03	$ 7.50	$ 10.51
Pretax Income	$ 1.17	$ 1.59	$ 3.55	$ 5.80	$ 7.93
Pretax Margin (%)	5.9	5.3	7.3	8.6	16.05
Effective Tax Rate (%)	1.2	1.7	4.7	4.7	5.5
Net Income	$ 0.61	$ 0.84	$ 1.88	$ 3.09	$ 4.33
Average Shares Outstanding (Millions)	1.16	1.18	1.58	2.30	4.70
Per Share					
Earnings	$ 0.53	$ 0.71	$ 1.30	$ 0.83*	$ 0.92
Dividends	0	0	0	0	0
Book Value	N/A	N/A	N/A	N/A	N/A
Price Range	N/A	N/A	N/A	N/A	N/A
Total Employees	N/A	311	400	558	550

N/A = Not Available
*Adjusted to reflect 2-for-1 stock split of September 1983

Source: Adage, Inc.,
Annual Report
DATAQUEST estimates

Adage, Inc.

THE COMPANY

Background

Adage, Inc., designs, manufactures, markets, and services interactive computer graphics terminals and systems. The Company was incorporated in Massachusetts in 1957 and entered the graphics field in 1968.

Highlights

In February 1983, the Company merged the operation of its wholly owned subsidiary, Ikonas Graphics Systems, Inc., into the parent corporation. The Ikonas Color Raster Display System is now known as the Adage 3000. It is manufactured, sold, and serviced by Adage.

In June 1983, the Company introduced the Adage Core System (ACS). Modeled after the proposed ACM/Siggraph Core Standard, ACS consists of a Fortran subroutine library and ACS microcode. ACS was designed to give the applications programmer a standard interface to stroke graphics and has been structured to off-load the host by performing most functions in the terminal.

Adage also introduced the Fortran Support Subroutines Package (FSS 3000) for the Adage 3000 Color Raster System, which features rapid image generation by multiple processors, programmable display formats, and large display memory capacity.

In July 1983, the Company announced the addition of a color raster workstation to its current 4250 product line.

The Company also announced the signing of an agreement with Intermetrics, a Cambridge, Massachusetts-based developer of compilers, graphics, data base management, and real-time applications software for aerospace and industrial systems. According to this agreement, Intermetrics will develop and market software tools and applications packages for Adage's color raster and vector refresh workstations.

In April 1984, the Company announced a product agreement with Adra Systems, Inc., a CAD/CAM spinoff from Applicon. The product, for which specifications, pricing, and availability will be announced this summer, will be marketed, supported, and serviced exclusively by Adage.

In May 1984, the Company signed an agreement with Nixdorf Computers for the joint marketing of the Adage 4250 and Nixdorf 8890. The Adage/ Nixdorf configuration is compatible with CADAM software.

Adage, Inc.

Adage responded to IBM's aggressively priced 5080 raster graphics product introduction by lowering its prices. With lower gross profit margins, DATAQUEST believes that Adage will formulate a more diversified product strategy so that the company is less dependent on the IBM-compatible portion of its business, which DATAQUEST estimates to be approximately 50 percent of 1984 revenues.

Operations

Adage's executive offices and 65,000-square-foot manufacturing plant are located in Billerica, Massachusetts. The Company currently has 46 sales and service offices in the United States, one office in Canada, and thirteen offices in Western Europe.

Adage's U.S. sales organization is divided into four regions, with headquarters as follows: Eastern Region, Billerica, Massachusetts; Central Region, St. Louis, Missouri; Western Region, Dallas, Texas; and European Region, Stuttgart, West Germany.

In Western Europe, Adage's sales and customer service operations are managed by its wholly owned German subsidiary, Adage GmbH, located in Stuttgart, West Germany. The Company's European sales force is augmented by independent sales representatives in France, Great Britain, Italy, and Spain.

The Company markets its products in Japan through distributor agreements with Nippon Univac Kaisha, Ltd., and Kanematsu-Gosho (U.S.A.) Inc. Each distributor is responsible for a different portion of Adage's product line.

Historically, Adage has marketed some of its equipment through a third-party leasing program that requires the purchase of Adage's equipment by the lessor. During the past three years, the equipment sold through this program has generated less than 5 percent of total revenues.

Marketing and Sales

Approximately 86 percent of Adage's 1984 revenues were derived from the sale of products. The maintenance and support of these products generate the remaining 14 percent of the Company's revenues. Non-U.S. revenues accounted for approximately 15 percent of Adage's total 1984 revenues.

Approximately 22 percent of Adage's personnel (123 employees) are engaged in providing customer service. These employees provide installation, warranty service, preventive and remedial service, and general assistance to customers. The Company's distributors provide equivalent service capabilities for their customers using personnel trained by Adage.

Adage offers service contracts that make complete maintenance service available for a fixed monthly charge. Per-call and on-site service are also available.

Research and Development

The Company is shifting its product development focus from vector refresh products to a concentration in raster graphics. Adage develops high-performance functionality for applications such as solids modeling, shading, and model transformation in hardware and software. There is a continuing effort to include local intelligence in the workstations.

Adage spent $5,430,400 (11 percent of its revenues) on product development in fiscal 1984.

Products

The Adage product line consists of the Adage 3000 color raster display system and the Adage 4000 Series vector refresh group. Adage manufactures, sells, and services its entire product line. The product line includes:

- Adage 3000--A color raster display, UNIX-supported operating system
- Adage 4000--A programmable vector refresh workstation available in one 2-D model (the 4115) and two 3-D models (the 4135 and the 4145); supports core graphics
- Adage 4177--A graphics workstation designed for use with the Sperry UNIS CAD System
- Adage 4250--Interactive color raster and vector refresh workstations for mainframe users; compatible with CADAM software
- Adage 4370--A three-dimensional vector refresh workstation; may be directly connected to IBM 360/370, and is compatible with Northrop's NCAD System
- Adage 4380--A graphics workstation with 2-D and 3-D capabilities that can emulate the IBM 3250; implements the full 3-D Adage, a 4370 graphics command set

Apollo Computer

Apollo Computer

Apollo Computer Incorporated
15 Elizabeth Drive
Chelmsford, Massachusetts 01824
Telephone: (617) 256-6600 TWX: (710) 343-6803
(Millions of Dollars Except Per Share Data)

Balance Sheet*

	1980**	1981	1982
Working Capital	$ 3.18	$ 5.69	$ 8.18
Long-Term Debt	$ 0.23	$ 0.91	$ 2.09
Shareholders' Equity	$ 3.33	$ 6.43	$ 11.76
After-Tax Return on Average Equity (%)	N/M	N/M	N/M

Operating Performance*

	1980	1981	1982
Revenue	$ -	$ 3.40	$ 18.10
Cost of Revenue	$ -	$ 2.20	$ 8.01
R&D Expense	$ 0.58	$ 1.67	$ 3.01
SG&A Expense	$ 0.64	$ 2.89	$ 6.84
Pretax Income	$ (1.08)	$ (2.99)	$ 0.31
Pretax Margin (%)	N/A	N/A	2
Effective Tax Rate (%)	N/A	N/A	N/A#
Net Income	$ (1.08)	$ (2.99)	$ 0.31
Average Shares Outstanding (Millions)	2.81	4.35	17.10
Per Share			
Earnings	$ (0.38)	$ (0.69)	$ 2
Dividend	0	0	0
Book Value	$ N/A	$ N/A	$ 0.67
Price Range	$ N/A	$ N/A	$25 1/4-50 1/2
Total Employees	N/A	N/A	416

N/A = Not Available
N/M = Not Meaningful
*Apollo Computer Incorporated's fiscal year ends on a different day each year: fiscal 1980 ended 3 January 1981; fiscal 1981 ended 2 January 1982; and fiscal 1982 ended 1 January 1983.
**Covers period from 13 February 1980 to 3 January 1981
#Effective tax rate for 1982 was 0 percent due to investment and R&D tax credits of $383,000.

Source: Apollo Computer Incorporated Prospectus
DATAQUEST

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Apollo Computer

BACKGROUND

The Company

Apollo Computer Incorporated was founded in February 1980 by Dr. John W. Poduska, Mr. Charles P. Spector, Mr. Robert M. Antonuccio, Mr. J. Michael Greata, Mr. David G. Lubrano, and Dr. David D. Nelson. The Company designs, manufactures, markets, and services computer systems used primarily in engineering, scientific, and other technical environments. Apollo computer systems are used in applications such as computer-aided design (CAD), computer-aided engineering (CAE), computer-aided software engineering (CASE), computer science research, engineering, and scientific problem solving.

On March 3, 1983, Apollo Computer listed its common stock on the NASDAQ National Market.

Operations

Apollo develops and manufactures its own hardware and software products. The Company's system, DOMAIN (Distributed Operating Multi-Access Interactive Network), consists of dedicated 32-bit general-purpose computers connected in a high-speed local area network. Each computational node can have up to 3.5 Mbytes of main memory, up to 154 Mbytes of mass storage, and high-resolution monochrome or color displays. The Company currently markets four DOMAIN models--the DN300, DN400, DN420, and the DN600.

Shipment of Apollo's first product, the DN400, began in March 1981. Volume shipments of the DN300, introduced in January 1983, began in March 1983.

Total revenue for Apollo Computer in fiscal 1982 was $18.1 million. For the first six months of 1983, ending July 2, total revenue was $31.728 million.

MARKETING

Currently, Apollo sells its products mainly in the United States. However, the Company is rapidly expanding into the European and Japanese markets. Apollo's subsidiaries maintain sales and service offices in France, Japan, and the United Kingdom. In the United States, Apollo organizes its sales operations into four major districts--northeast, north central, southern, and western.

Apollo Computer

Apollo's primary sales targets are Fortune 500 and 1000 companies for direct end-user sales and CAE/CAD/CAM system OEM accounts. The Company has been successful in selling to OEMs involved with computer-aided engineering (CAE), design automation, and computer-aided design (CAD). Apollo's systems are well suited to standalone workstation applications in various CAD/CAM and CAE segments.

Apollo's 1982 customer base was dominated by three OEM customers--Auto-trol (29 percent), Calma (13 percent), and Mentor (11 percent)--which totaled 53 percent of Apollo's business during that year. Other large OEM customers included CAE Systems Inc. and MacNeal-Schwendler Corporation. Significant end-user customers were Bendix Corporation, Brown University, Harvard University, and Yale University.

RESEARCH AND DEVELOPMENT

Apollo maintains an ongoing program of research and development designed to provide, at reasonable prices, new products to enhance engineering productivity. During 1980, 1981, and 1982, the Company spent approximately $582,000, $1,674,000, and $3,005,000, respectively, on research and product development.

MANUFACTURING

The Company's manufacturing operations are carried on at its Chelmsford, Massachusetts, facility and consist primarily of high-level assembly, test, and quality control of materials and components. Manufacturing operations are organized into three functional business units--components, large systems, and small systems.

Apollo generally uses standard parts and components for its products. This approach affords Apollo the flexibility to quickly integrate advances in technology into its products.

ORGANIZATION

As of January 1, 1983, Apollo employed 416 persons full time. Of the employees engaged in product development, approximately half are engaged in hardware development, while the remaining half work on software development.

Apollo Computer

The Company's corporate offices and manufacturing facility are located in Chelmsford, Massachusetts, in a new, leased 128,000-square-foot building. In addition, Apollo has signed a lease for an adjacent 80,000-square-foot manufacturing facility, which the Company expects to occupy in late 1983. The Company also leases an aggregate of approximately 34,000 square feet for sales, service, and administrative offices.

PRODUCT SUMMARY

The Apollo systems represent a unique architecture supporting a new way of using computers and offering substantial performance for a relatively low price. These products directly address the needs of technical professionals who require high-performance, low-cost graphic systems that can share information among various users.

By interconnecting independent minicomputers, the DOMAIN local area network combines the power and high degree of interactiveness offered by dedicated minicomputers with the economy of shared-system resources. Apollo has developed three key elements to provide this capability:

- Virtual memory distributed over the network rather than being localized in only one computer

- High-speed, high-resolution graphics features extending the range of applications for DOMAIN networks

- The proprietary AEGIS Operating System, which directs and controls all network activities

These elements enable each node or network connection to handle large and demanding applications, such as those in the engineering and scientific areas, at a small fraction of a mainframe computer's price. In addition, potentially hundreds of nodes can be integrated to form a single, powerful computing environment.

Network Architecture--The DOMAIN Local Area Network

The DOMAIN local area network is a ring network in which a user's node has direct access to data and devices anywhere in the network, just as if the data and devices were physically stored in or coupled to that node itself. Communication around the network takes place at 12 million bits per second, which is comparable to the access speed of a minicomputer to its mass storage devices. The ring network is a communications channel using a coaxial cable over which data such as text, graphic images, engineering documents, reference materials, and letters can rapidly be made available to the entire network user community. Each node can use the storage resources, including related mass storage devices, of every other node in the network.

A principal design component of the DOMAIN ring is the distribution of virtual memory across all the nodes in the network under the control of the AEGIS Operating System.

The CPU

The Apollo system architecture uses the Motorola 68000 series microprocessor as the heart of the system. The newly announced DN300 uses the new 68010 microprocessor with electronic page fault support. Older DN models (DN400, DN420, DN600) use two 68000s to handle page faults. Both microprocessors have 32-bit internal operations and 16-bit I/O functions.

The memory management unit translates the 24-bit virtual address space out of the 68000 and into a 22-bit physical address in the Apollo node. This unit operates on a 1-Kbyte physical page and has separate protection and statistical information for each page.

The CPU has a 1.2-Mbyte floppy disk separate from the main bus for system booting and for remote diagnostic support.

Peripherals

Apollo offers a wide range of peripheral disk types and printers, all of which can be shared by users on the network. Disks include a 1.2-Mbyte floppy and a 34-, 68-, or 158-Mbyte Winchester. Using a peripheral node adaptor, the system can accept two 300-Mbyte Ampex disk drives, a Cipher 1,600-bpi/25-ips tape drive, or a 300/600-line-per-minute Printronix printer; these devices are available from their respective vendors. In addition, Apollo offers a MULTIBUS industry-standard interface (IEEE-796) that allows a user to connect any MULTIBUS-compatible device to a node.

A new product introduction, the Distributed Server Processor (DSP 80), a displayless node controller, is designed to act as a storage node, a printing node, or a communications controller to systems outside the DOMAIN network.

A Performance Enhancement Board (PEB) containing both high-speed buffer memory and a special processor for performing floating point arithmetic is also available.

SOFTWARE

The Apollo systems run the proprietary AEGIS Operating System. Apollo also has an adaptation of Bell Laboratories' UNIX III system, named AUX, which runs under AEGIS. The DOMAIN local area networking software allows the simultaneous operation of both AEGIS and AUX operating systems.

In addition, Apollo offers software modules for data base management, a high-level language debugger, a common code generator, a font editor, remote diagnostic support, interprocess communications, asynchronous ASCII terminal emulation, IBM 3270 communications, HASP support, a communications option for Ethernet, and X.25 telecommunications protocol.

Graphics

The graphics system employs bit-mapped raster-scan display technology, where each graphic image is broken down into a series of discrete points called pixels. Each pixel on the screen has an associated word or byte in the display memory that describes whether the pixel is on, off, or at some level in between (which generates a gray scale).

A dedicated bit-slice, 180-nanosecond display processor refreshes the image at a rate of 30 or 60 times per second and displays it on either a 15-, 17-, or 19-inch diagonal screen, depending on the model. The DN600 is capable of displaying an image in color from a palette of more than 16 million colors and features software-reconfigurable screen resolution. The DN300, DN400, and DN420 have black-and-white displays.

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Applicon Incorporated

Applicon Incorporated
(A Wholly Owned Subsidiary of Schlumberger Ltd.)
32 Second Avenue
Burlington, MA 01803
(617) 272-7070 Telex: 94-9345
(Millions of Dollars Except Per Share Data)

(Applicon is a wholly owned subsidiary of Schlumberger Ltd.; therefore, current balance sheet data are unavailable.)

Balance Sheet (April 30)

	1977	1978	1979	1980	1981
Working Capital	$ 5.88	$ 4.77	$ 5.94	$12.47	$27.24
Long-Term Debt	$ 4.76	$ 4.55	$ 6.31	$12.65	$ 1.03
Shareholders' Equity	$ 2.63	$ 2.36	$ 2.97	$ 5.96	$39.26
After-Tax Return on Average Equity (%)	30	(28.7)	25	14	14

Operating Performance (Fiscal Year Ending April 30)

	1977	1978	1979	1980	1981
Revenue	$16.64	$18.37	$28.47	$50.92	$74.81
U.S. Revenue	$13.98	$15.55	$23.29	$41.64	$52.53
Non-U.S. Revenue	$ 2.66	$ 2.82	$ 5.18	$ 9.28	$22.28
Cost of Revenue	$ 9.48	$11.60	$15.74	$23.66	$33.08
R&D Expense	$ 1.40	$ 2.35	$ 2.54	$ 5.67	$ 8.33
Marketing Expense	$ 2.61	$ 3.48	$ 5.90	$11.12	$17.34*
G&A Expense	$ 1.19	$ 2.00	$ 2.51	$ 3.32	$ 5.78*
Pretax Income	$ 1.69	($ 1.26)	$ 1.39	$ 5.94	$10.19
Pretax Margin (%)	10.0	(7.0)	4.7	11.6	13.5
Effective Tax Rate (%)	46.7	56.9	49.4	53.0	53.8
Net Income	$ 0.77	$(0.76)	$ 0.67	$ 3.15	$ 5.49
Average Shares Outstanding (Millions)	2.45	2.08	3.80	4.60	5.70
Per Share					
Earnings	$ 0.32	($ 0.39)	$ 0.19	$ 0.68	$ 0.96
Dividend	0	0	0	0	0
Book Value	N/A	N/A	N/A	N/A	N/A
Price Range	N/A	N/A	N/A	N/A	N/A
Total Employees	336	496	572	785	1,050

N/A = Not Available
*Estimated

Source: Applicon Incorporated
DATAQUEST Estimates

Applicon Incorporated

THE COMPANY

Background

Applicon was founded in Massachusetts in 1969 as Analytics. The Company changed its name to Applicon Incorporated in early 1970, the same year that it introduced the world's first turnkey minicomputer-based interactive graphics system. Applicon was acquired by Schlumberger Ltd. in January 1982. Applicon operates as a wholly owned subsidiary of Schlumberger and is part of the Computer-Aided Systems business unit, which was formed in October 1983 to address the CAD/CAM and CAT markets.

Highlights

Alex N. Beavers, Jr., was appointed president of Applicon in July 1984. Mr. Beavers joined Applicon from General Electric's Intelligent Visual Systems Operation.

Applicon made several major announcements during 1983. Among them were:

- Compliance with the Initial Graphics Exchange Standard (IGES) with the addition of IGES pre- and postprocessor utility programs
- An agreement with Algorex Corporation whereby Algorex will supply Applicon with its batch PCB design software
- A marketing agreement with MacNeal Schwendler to license its MSC/NASTRAN software
- A new 4620 color raster-scan workstation that offers complete graphics capabilities
- A new 4630 modular raster-scan workstation that also offers complete graphics capabilities, and is plug-compatible with the Applicon Series 4000
- BRAVO!, a CAD/CAM product that integrates capabilities for design, analysis, and manufacturing applications

BRAVO! represented a major milestone for Applicon. This three-year, $22 million R&D investment is the core graphics functionality from which all application software is developed and integrated. In addition, Applicon became the first major turnkey vendor to unbundle certain applications software.

Applicon Incorporated

Operations

Applicon's headquarters are in Burlington, Massachusetts. The Company employs 1,200 people in 43 offices worldwide.

Applicon's European headquarters are located in Paris, France. The Company has nine European offices located in Brussels, Belgium; Milan, Italy; Diemen, the Netherlands; Lidingo, Sweden; Zurich, Switzerland; Cheshire and Hertfordshire, the United Kingdom; and Frankfurt and Munich in the Federal Republic of Germany. It also has two offices in Canada in Toronto and Montreal.

Financial information for Applicon has been unavailable since its acquisition by Schlumberger. DATAQUEST estimates that Applicon's 1983 CAD/CAM revenues were $112 million, a 24 percent increase over 1982's estimated revenues of $91 million. Revenues were not as high as originally anticipated, due to delays in the shipment of the newly introduced BRAVO!

Research and Development

Applicon's R&D activities are concentrated in Santa Clara, California, for its microelectronics products, and in Burlington, Massachusetts, for all other products.

PRODUCTS

Applicon products have evolved to include multiapplication and multiprocessor solutions. Its current product line is described throughout the remainder of this section.

BRAVO! is a VAX-based system that integrates capabilities for design, analysis, and manufacturing applications. The BRAVO! software is supported on Digital Equipment VAXes supplied either by Applicon or by its customers. BRAVO! system software includes:

- The Applicon Editor--a menu-driven graphics editor for creating, editing, and maintaining a graphics data base. The Editor supports up to eight windows displayed simultaneously, and maintains association between layers and text.

- Applicon Graphics Language (AGL)--a user graphics programming language based on PL/1 to allow customer graphics applications programming.

- Applicon Database Manager--a data management system that creates data structures on the record level, which will allow common data base access from an unlimited number of application programmers. The Database Manager is the foundation on which all BRAVO! application software is built.

Series 4000

The Series 4000 is Applicon's VAX-based CAD/CAM product line. Applicon directly OEMs the VAX 11/730 and 11/751 from Digital Equipment Corporation. However, BRAVO! and its workstations can be installed on a customer-supplied VAX 11/780. The Series 4000 includes the following systems and workstations:

Systems

The 4265 Graphics Processing Facility (GPF) offers 32-bit virtual memory architecture graphics processing. The single-bay GPF runs on the Digital VAX-11/730 processor with a VAX/VMS operating system. It supports two to five Mbytes of memory, and has a 160-Mbyte disk drive (expandable to a 760-Mbyte disk), and a dual-density tape drive.

The 4275 Graphics Processing Facility offers 32-bit virtual memory architecture graphics processing. This double-bay GPF runs on a Digital VAX-11/751 processor with a VAX/VMS operating system. The 4275 supports three to eight Mbytes of memory, and has a disk controller that will support up to four 80-, 160-, or 300-Mbyte disk drives, and a dual-density tape drive.

Workstations

The 4620 Desktop Color Raster workstation is compatible with the Applicon 4265 and 4275 systems. It features a 13-inch 60-Hz noninterlaced refresh graphics display. The 4620 will run CP/M-86 programs when it is not performing CAD-related applications.

The 4630 Modular Color Raster workstation is also compatible with the Applicon 4265 and 4275. It features a 13-inch, noninterlaced 60-Hz refresh graphics display.

The 4650 Color Raster workstation, also compatible with the Applicon 4265 and 4275, features a 19-inch noninterlaced 60-Hz refresh graphics display.

Applications Software

BRAVO! supports Applicon's mechanical and printed circuit board CAD applications. The mechanical applications are listed below.

- Solids Modeling II is Applicon's second-generation solids modeler. This product features immediate visual feedback, hidden line removal, and analysis capabilities.

- The Bill of Materials Package extracts part and description lists from graphics DBS created on the 4820 and generates Bill of Material Reports in a variety of formats.

- The 4956 Surface Modeling combines mathematical algorithms and graphics, and allows designers to create and manipulate analytic shapes.

- GRAFEM is a graphics finite element modeling package that provides pre- and post-processing capability to create and analyze finite element models.

- IFAD is an integrated finite element analysis package that interfaces with GRAFEM. It is a structured analysis package that performs on-line linear, static, and dynamic analysis.

- Mechanisms calculates static equilibrium and time responses for multifreedom rigid body mechanical systems. It is based on DRAM from Mechanical Dynamics, Inc., of Ann Arbor, Michigan.

Applicon's PCB software is based on programs licensed from Algorex, a manufacturer of PC boards based in Long Island, New York. The Algorex software provides complete batch-oriented design software that is integrated with the BRAVO! interactive graphics system.

To date, Applicon has not developed layout software for its VAX-based products. The Company's integrated circuit (IC) design package, CASL (Color Associated Symbolic Layout), allows designers to take advantage of CAD/CAM assisted UC design while maintaining high densities traditionally associated with handcrafted layout.

For more information on Applicon's product line, please refer to Tables 1 and 2.

Applicon Incorporated

Table 1

Applicon Incorporated
CAD/CAM SYSTEM PRODUCTS

Name	Manufacturer	Type	Word Size	Workstations Supported
Systems				
VAX-11/730	Digital Equipment Corporation	Host-Dependent	32-bit	4 max.
VAX-11/751	Digital Equipment Corporation	Host-Dependent	32-bit	8 max.
VAX-11/780*	Digital Equipment Corporation	Host-Dependent	32-bit	16 max.

Name	Type	Resolution	Display Colors
Workstations			
4620	Host-Dependent	672 x 504	8 max.
4630	Host-Dependent	768 x 576	256 max.
4650	Host-Dependent	768 x 576	256 max.

Name	MEC	AEC	IC	PC	EDA	MAP
Base Software						
BRAVO!	X			X		
4820 Applicon Editor	X			X		
4821 Database Manager	X			X		
4822 Applicon Graphics Language	X			X		

*Customer Supplied

Source: DATAQUEST

Table 2

Applicon Incorporated
APPLICATIONS PRODUCTS

	MEC	AEC	IC	PC	EDA	MAP
Solids Modeling II	X					
Bill of Materials	X					
GRAFEM	X					
IFAD	X					
Surface Modeling	X					
Mechanisms	X					
PCB Design Package				X		
CASL			X			
Design Rule Check			X	X		
Placement				X		
Router				X		

Source: DATAQUEST

3/3/83

APPLICON CORPORATE ORGANIZATION

The company was founded in 1969 as ANALYTICS, Inc by a group of programmers from MIT's Lincoln Laboratory where they had been working on advanced interactive graphics systems. The four principals, all of whom had PhD's, were Gary Hornbuckle, Fontaine Richardson, Richard Spann, and Harry Lee. The name was changed to APPLICON early in 1970.

Early effort centered on developing IC design software based upon their work at Lincoln Lab. An IBM 1130 was the initial target computer system. Very shortly thereafter, they switched to DEC PDP-11 CPU's and have used them ever since. One of the system's key features since inception has been the use of a tablet pattern recognition technique for command entry. This approach to man-machine communication was originally developed by the founders while they ere at Lincoln Lab.

Market orientation was initially IC design with sales effort focused on the R&D departments of the target companies. This contrasted sharply with CALMA's and COMPUTERVISIONS's efforts in those days which were aimed more at the production drafting personnel. Applicon has been quite successful in the IC market and with a 30% market share, is second only to CALMA. They have also been successful in the PC market where they have a 12% market share. Their third major segment is in Mechanical where they have a 4% share. In the latter two areas, market share has slipped substantially in the last two years as new competitors have taken share away from APPLICON.

APPLICON was substantially financed in its early days by several venture capital firms led by a division of GE. In fact, at one time GE owned nearly 22% of APPLICON. In the late 1970's, the company ran into substantial financial problems and a new management team was brought in. This team was led by Don Federson who had been President of ENTREX until it was acquired by NIXDORF. Federson very quickly brought in a number of former ENTREX executives, and today, they have totally replaced the original founders. It is interesting to note how the company went from being the industry's technology leader to a company with a weak product line as it went from being lead by a group of technology types to being lead by a group of "businessmen".

In 1980 APPLICON went public with a successful stock offering. Prior to this offering, GE offered to purchase the remaining stock in the company. When this offer was turned down, GE went shopping and eventually purchased CALMA. This resulted in GE subsequently selling its interest in APPLICON. In late 1981, APPLICON agreed to merge with SCHLUMBERGER for a stock exchange then valued at $220M. SCHLUMBERGER is a French controlled company, charted in the NETHERLANDS ANTILLES, and headquartered in New York. Its primary business is in oil field services where it owns a number of service and product companies. It also owns FAIRCHILD SEMICONDUCTOR and other high tecnology companies.

About the same time SCHLUMBERGER acquired APPLICON, it purchased MDSI in a similier deal. The two companies are now being run as divisions of a single organization. SCHLUMBERGER has also recently agreed to acquire a 70% interest in BENSON, a French based plotter manufacturer.

2/15/83

KEY PERSONNEL

Don Federson- President of combined Applicon and MDSI operation/ was president of Applicon when it was acquired by Schlumberger/ previously President of Entrex/ joined Applicon in April, 1978

David Barber- VP,Marketing/ formerly with Entrex as VP, Engineering and VP, Distributor Sales

Robert MacCormack- VP, International Marketing

R. Stephen Cheryl- VP, Finance/ formerly with Entex and American Pacemaker

Dr. Richard Diephuis- VP, Systems Development

Thomas Genova- VP, Engineering

Arthur Reidel- VP, Product Development

Dr. John Horgan- Director, Mechanical Applications Development

William Mason- VP,Operations

Ken Estey- VP, Field Engineering

Jim Sweeney- Director, National Sales/ former Tektronix District Sales Manager

3/3/83

APPLICON PRODUCT DESCRIPTION

OVERVEIW

APPLICON's current product line is called the SERIES 4000.

COMPUTERS

4225 SATELLITE GRAPHICS PROCESSOR: Based on the DEC PDP 11/34, the 4225 has 216KB of memory, an 80MB disk and APPLICON's 32-bit grahics processor. The GRAPHICS 32 is part of all APPLICON systems and handles many of the viewing functions such as windowing and clipping. The 4225 will support 4 workstations and can be upgraded to a 4245 or 4275. It does not have a tape drive and is intended to be used only as a satellite to a 4245 or 4275. Communication between 4200 Series systems is via DECNET.

4245 GRAPHICS PROCESSING FACILITY: This unit is nearly identical to the 4225 except that it includes a tape drive and a 300MB disk drive. It is a standalone version of the 4225 and also can support 4 workstations.

4275 GRAPHICS PROCESSING FACILITY: Based on the VAX 11/751 (OEM version of the 11/750), this unit can support up to 10 workstations as well as provide additional processing power to 4225 and 4245 systems that are linked to it via DECNET. A number of APPLICON software packages require the 4275. These include solids (SYNTHAVISION), data base management, finite element analysis, and their new graphics language (AGL).

VIDEO DESIGNER: This appears to be a standalone packaged version of the 4225 system. It consists of a PDP-11/34 CPU, a 32-bit Display Processor, a 200MB disk, mag tape drive, and a B&W workstation. A color option is available as is a second workstation. Since this system was introduced, little more has been heard of it.

WORKSTATIONS

4640 MONOCHROME RASTER-SCAN WORKSTATION: This is a single 19" display workstation with 768 x 576 resolution. Alphanumeric information is interchanged with the graphic picture. A single status and prompt line is also used. The physical arrangement is very flexible.

4650 COLOR RASTER-SCAN WORKSTATION: Similiar to the 4640, this unit also has 768 x 576 resolution. It supports 7 predefined colors and will handle selective entity manipulation.

ENHANCED COLOR GRAPHICS: Options are available to smooth out jagged lines (PERL or PERCEPTION ENHANCED RESOLUTION LOGIC) and to provide 256 selectable colors.

SYSTEM HARDWARE

GRAPHICS-32 DISPLAY PROCESSOR: In order to achieve an acceptable level of performance with small 16-bit mincomputors, APPLICON has been using a special purpose graphics processor that they designed and build. It offloads from the CPU some of the graphics operations such as clipping and polygon fill. It is not clear if this unit is standard or an option.

SOFTWARE

OPERATING SYSTEMS: The 4225 and 4245 use RSX-11M while the 4275 uses VMS.

4700 GRAPHICS OPERATING SYSTEM-IMAGE: This is the system software that ties RSX-11M together with the GRAHICS 32 processor and the 2D and 3D graphics software. It appears that it is not part of 4275 system. Interactive graphics software will not be available on the 4275 until sometime in 1983.

4710 2D GRAPHICS APPLICATION SYSTEM: This software is primarily oriented to schmatic drawing and PC boards. For general drafting it appears to be much more limited than GSX.

4750 3D GRAPHICS APPLICATION SYSTEM: The 4750 system is similiar to GS-32 in that it is a multi-view surface oriented package. Mechanical drafting is done within this package. It is not necessary to go to the 2D system to generate drawings.

SOLIDS: The current APPLICON solids product is MAGI SYNTHAVISION that has been licensed by APPLICON for sale to their customers. A part is created in wire frame mode and then sent to SYNTHAVISION for producing a shaded image view. Parts can apparently be design directly in SYNTHA-VISION but there is no capability to take data from SYNTHAVISION back to the standard 2D or 3D software. Use of this package requires a VAX.

NC GRAPHICS: This package was originally developed by MDSI to provide a graphic front end to their COMPACT-II NC part programming language. It has since been brought up on APPLICON hardware and is offered as an option on their VAX system.

DGN (DISTRIBUTED GRAPHICS NETWORK): This software package allows the access and transfer of data files between 4200 Series systems using standard communication products such as DECNET. It is NOT a Local Area Network as we are familiar with them.

AGL (APPLICON GRAPHICS LANGUAGE): User applications can be programmed in this language.

Database Management: A DBMS system is being developed for operation on the VAX that will provide a CODASYL compliant capability. It is based upon the SEED system and is designed to work with AGL.

APPLICATIONS

- Numerical Control
- Flat Pattern Development
- Bill of Material Generator
- Nesting and Flamecutting
- Finite Element Modeling
- Finite Element Analysis Output Display
- PC Board Design
- PC Board Routing
- IC Design and Maskmaking
- Wire List Generator
- Ladder Diagram Cross-reference
- Technical Documentation
- Piping Design
- Architectural Drafting (BASE A/E)

2/16/83

APPLICON PRICES

ALL PRICES SHOULD BE TREATED AS ESTIMATES

SYSTEMS

4225	PDP-11/34, 216KB Memory, 80MB Disk, Alpha CRT, B&W Workstation	99,500
4245	PDP-11/34, 216KB Memory, 300MB Disk Mag Tape, B&W Workstation	172,000
4275	VAX 11/751, 1MB Memory, 300MB Disk Mag Tape, NO Workstation in base price	160,000
VIDEO DESIGNER	PDP-11/34, Display Processor Mag Tape, 200MB Disk, B&W Workstation , Graphics Software	150,000

SYSTEM OPTIONS

????	GRAPHICS-32 Display Processor	15,000
????	Communications Interface for HASP or 2780	20,000

WORKSTATIONS

4640	B&W Workstation with tablet and keyboard	40,000
4650	Color Workstation with tablet and keyboard	70,000

PLOTTERS

????	Terminal Hard Copy Unit	8,750

SOFTWARE

????	FORTRAN Interface	6,000
????	FORTRAN	6,000
????	Numerical Control	15,000
????	Bill of Materials	6,000
????	Nesting and Flamecutting	15,000
????	BASE A/E (Architectural Drafting)	2,500
????	PC DESIGN	22,500
????	PC Placement and Routing	33,500

????	Wirelist	17,500
????	Ladder Diagram	14,500
????	SOLIDS	50,000
????	NC GRAPHICS (MDSI)	79,600

3/3/83

APPLICON'S PITCH

1. Ease of use

2. DEC hardware

3. High performance - applicable to VLSI design activity

4. Command recognition using operator defined patterns on tablet

5. Workstation layout is optimized for effective user interaction. This includes a tiltable, swivelable, moveable screen and the fact that it can be set up for either right-hand or left-hand use.

COUNTER: CC-80 packaging has been considered by most industry observers to be the best in the industry. Of particular importance is the separate COMTEC and the ACTEC.

6. On-line programming simultaneous with graphics

7. Strong IC design software - probably the best of the major turnkey vendors

8. SCHLUMBERGER financial stength

9. MDSI link for NC Postproccessors is being pushed very actively.

COUNTER: ATTC also provides an interface to COMPACT-II.

10. 32-bit graphics processor improves graphics performance.

11. APPLICON has introduced a hardware tehnique for smoothing out the jagged lines on their raster display. The industry nomelclature is anti-ailising while they call their approach PERL.

COUNTER: This approach results in longer display times when invoked. With the recent reductions in the cost of memory, it has become more feasible to go to higher resolution displays to obtain smoother line quality.

12. They claim that their 4000 Series system requires less site preparation than other systems.

COUNTER: AGW will go into standard room environments in most cases.

13. The SYNTHAVISION solids capability is being pushed very hard as the first such capability in the industry.

COUNTER: As currently used by APPLICON, SYNTHAVISION is being used as an image display tool. It is not an interactive Solids design capability in its present form.

14. They have demonstrated support for IGES.

15. Drafting features include dual dimensioning and tolerancing.

3/3/83

APPLICON KNOCKOFFS

1. Overall response time is slow.

2. Raster resolution is low - only 512 lines for both color and B&W. Their optional antiailising hardware (PERL) tends to compensate for this. Also, the workstation has no dynamic shape dragging capability.

3. There have been questions about software quality

4. DEC hardware is modified to where it is non-standard and probably will not support third party software. Also, special terminals would be needed.

5. Service quality is questionable and DEC remote diagnostics are not available on VAX systems sold by APPLICON.

6. System is not oriented to multiple applications at the same time - (this could change with new VAX 11/750)

7. Color range is low - only 7 colors which are preset by APPLICON. An optional 256 color unit with selectable colors is available. This expanded unit is probably required for doing solid modeling.

8. No separate text display such as ATTC COMTEC

9. The new 4225 and 4245 Graphic Systems are based on the DEC PDP 11/34. This is a relatively old version of the PDP 11 product line. It is slow by today's standards and has a maximum memory of 256KB. Each system can support only 4 workstations. In fact, it is hard to tell what the real differences are between these units and the prior AGS product line.

10. Each workstation can not be more than 2000' from a processor. In fact, the second workstation links to the first, the third to the second and so forth. The total path from the CPU to the last workstation must be less than 2000'.

11. Their function keyboard has 64 buttons compared to the 240 on the ACTEC.

12. No HP plotters are available. It also will be interesting to see if they begin pushing BENSON electrostatic plotters instead of VERSATEC now that SCHLUMBERGER is acquiring BENSON.

13. They have two separate graphic systems, one for 2D and one for 3D.

14. The 2D software has a resolution of only 32,768 units as compared to 14 digits in GSX.

15. They provide only 16 layers with a technique they call BINs to achieve 256 effective layers. Each layer can also be part of one of 16

BINs. This is very similiar to the way we used WINDOWS in GS-1000 to obtain 256 layers and we know the problems that caused.

16. Since their software has been running on DEC hardware in FORTRAN for a number of years, why has it taken them so long to bring it up on the VAX 11/750? This software is over a year behind schedule.

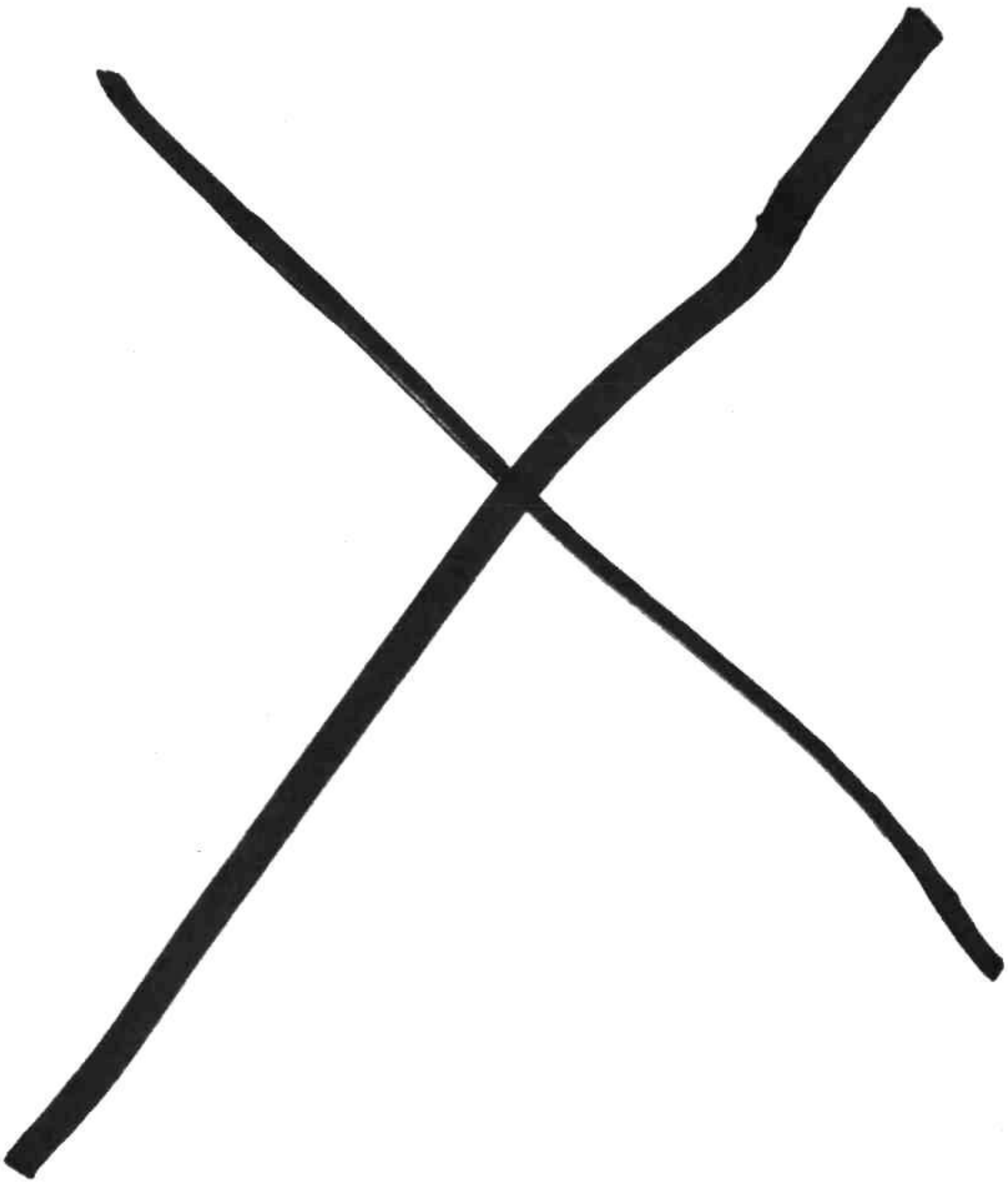
17. The software is not available on large VAX systems such as the 11/780 and 11/782.

18. The interaction between the 16-bit and 32-bit computers is not transparent to the users. It must be treated as a CPU to CPU transfer.

19. The 32-bit 4275 (VAX 11/750) is required to run analytical programs and SYNTHAVISION solids.

20. Use of SYNTHAVISION solids package involves building a wire frame model and passing it to SYNTHAVISION. Changes at the solids level cannot be passed back to the APPLICON data base.

21. When compared to GS-32, APPLICON software can only display 4 views at one time.



Auto-trol Technology Corporation

Auto-Trol Technology Corporation
Denver, Colorado 80233
Telephone: (303) 452-4919 TWX (910) 320-0772
(Millions of Dollars Except Per Share Data)

Corporate Financial Profile as of December 31

Balance Sheet Data

	1982	1983	1984	1985	1986	CAGR 1982-1986
Working Capital	$ 10.2	$ 15.3	$ 15.2	$ 10.5	$ 7.6	3.8%
Long-Term Debt	$ 5.8	$ 5.1	$ 5.3	$ 8.3	$ 7.6	5.5%
Shareholders' Equity	$ 21.7	$ 30.1	$ 34.6	$ 30.2	$ 24.3	6.6%
After-Tax Return on Average Equity	(28.8%)	(1.3%)	8.5%	(36.0%)	(25.9%)	
Operating Performance						
Revenue	$ 44.0	$ 54.1	$ 68.9	$ 65.4	$ 62.4	9.0%
U.S. Revenue	$ 38.8	$ 47.4	$ 61.0	$ 52.5	$ 52.1	7.3%
Non-U.S. Revenue	$ 5.2	$ 6.7	$ 7.9	$ 12.9	$ 10.2	17.7%
Cost of Goods Sold	$ 27.7	$ 30.4	$ 36.0	$ 39.0	$ 34.8	10.7%
Gross Margin	$ 16.3	$ 23.7	$ 32.9	$ 26.4	$ 27.5	6.7%
Expenses	$ 25.3	$ 24.0	$ 29.1	$ 34.4	$ 33.9	9.4%
R&D Expense	$ 8.1	$ 8.0	$ 8.5	$ 12.3	$ 9.2	11.3%
SG&A Expense	$ 17.2	$ 16.0	$ 20.6	$ 22.1	$ 20.8	8.4%
Other Expense	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 3.9	N/M
Operating Income	($ 9.0)	($ 0.3)	$ 3.8	($ 8.0)	($ 6.4)	22.0%
Interest Income (Expense)	$ 0.0	$ 0.0	($ 1.1)	($ 2.1)	($ 0.7)	N/M
Other Income	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0	N/M
Income before Tax	($ 9.0)	($ 0.3)	$ 2.8	($ 10.1)	($ 7.1)	29.4%
Note: Pretax Margin	(20.5%)	(0.6%)	4.0%	(15.4%)	(11.3%)	
Taxes	($ 2.5)	$ 0.0	$ 1.3	$ 1.6	$ 0.0	N/M
Note: Effective Tax Rate	27.8%	0.0%	47.2%	(15.7%)	0.0%	
Extraordinary Credit*	$ 0.0	$ 0.0	$ 1.3	$ 0.0	$ 0.0	N/M
Net Income after Tax	($ 6.5)	($ 0.3)	$ 2.8	($ 11.7)	($ 7.1)	76.6%
Shareholder Data						
Average Shares Outstanding (Millions)	3.6	3.9	4.7	4.8	6.5	10.7%
Per Share Data						
Earnings	($ 2.10)	($ 0.84)	($ 0.58)	($ 2.43)	($ 1.08)	23.6%
Dividends	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	0.0%
Book Value	$ 6.03	$ 7.72	$ 7.31	$ 6.28	$ 3.74	(3.7%)
Price Range (Low)	8 1/4	12 1/2	7 1/4	3 1/2	3 1/8	
(High)	19 5/8	29 1/8	25 1/8	12 3/4	12 3/4	
Total Employees	564	579	666	672	631	5.7%
Revenue per Employee	$78,014	$93,389	$103,494	$97,262	$98,824	3.2%

N/M = Not Meaningful
*Tax reduction from net operating loss carryforward.

Source: Auto-trol Technology Corporation
Dataquest
August 1987

Line Items as a Percent of Revenue

	1982	1983	1984	1985	1986	CAGR 1982-1986
Operating Performance						
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%
United States	88.2%	87.7%	88.5%	80.3%	83.6%	(1.6%)
Non-United States	11.8%	12.3%	11.5%	19.7%	16.4%	8.0%
Cost of Goods Sold	63.0%	56.2%	52.2%	59.6%	55.9%	1.6%
Gross Margin	37.0%	43.8%	47.8%	40.4%	44.1%	(2.1%)
Expenses	57.5%	44.4%	42.2%	52.6%	54.4%	0.4%
R&D Expense	18.4%	14.8%	12.3%	18.8%	14.8%	2.1%
SG&A Expense	39.1%	29.6%	29.9%	33.8%	33.3%	(0.5%)
Other Expense	0.0%	0.0%	0.0%	0.0%	6.3%	N/M
Operating Income	(20.5%)	(0.6%)	5.6%	(12.2%)	(10.2%)	12.0%
Interest Income (Expense)	0.0%	0.0%	(1.6%)	(3.2%)	(1.1%)	N/M
Other Income (Expense)	0.0%	0.0%	0.0%	0.0%	0.0%	N/M
Income before Tax	(20.5%)	(0.6%)	4.0%	(15.4%)	(11.3%)	18.7%
Taxes	(5.7%)	0.0%	1.9%	2.4%	0.0%	N/M
Net Income after Tax	(14.8%)	(0.6%)	4.0%	(17.9%)	(11.3%)	62.0%

Source: Auto-trol Technology Corporation
Dataquest
August 1987

THE COMPANY

Founded

Auto-trol Technology Corporation was incorporated in 1962 in Denver, Colorado.

Positioning

Auto-trol sells and supports software and turnkey systems in mechanical, facilities design, and mapping applications, and derives all of its revenue from CAD/CAM markets. The Company's performance and market share history are shown in Tables 1 and 2.

Table 1

Auto-trol
CAD/CAM Performance
(Millions of Dollars and Actual Units)

	1982	1983	1984	1985	1986
Revenue	$ 44	$ 54	$ 69	$ 65	$ 62
Workstation Shipments	$ 394	$ 293	$ 414	$ 531	$ 702
Workstations Installed	$1,994	$2,287	$2,701	$3,232	$3,934

Source: Dataquest
August 1987

Table 2

Auto-trol
CAD/CAM Market Share History
(Percentage of Segment)

	1982	1983	1984	1985	1986
All Applications					
Revenue	3%	2%	2%	1%	1%
Workstation Shipments	4%	2%	1%	1%	0%
Mechanical					
Revenue	2%	2%	2%	1%	1%
Workstation Shipments	3%	1%	1%	1%	0%
Facilities Design					
Revenue	13%	8%	6%	4%	3%
Workstation Shipments	11%	6%	2%	1%	1%
Mapping					
Revenue	3%	2%	0%	0%	0%
Workstation Shipments	2%	0%	0%	0%	0%

Source: Dataquest
August 1987

FINANCIAL

Auto-trol's revenue for the first quarter (ended March 31, 1987) was $18.0 million, with net earnings of $0.5 million.

Financing

Auto-trol held its first public offering of common stock in 1979. Three additional offerings were held in 1980, 1982, and 1983, with net proceeds to the Company of $11.3 million, $5.2 million, and $11.8 million, respectively.

HIGHLIGHTS

Listed below in reverse chronological order are recent company highlights:

- January 1987—Auto-trol and Selenia agreed to dissolve their European joint venture, Italcad. Auto-trol will now operate its subsidiaries in France, Germany, Sweden, and the United Kingdom; Selenia will maintain Italian operations.
- November 1986—Auto-trol entered into an OEM agreement with Interleaf, Inc., for Interleaf's desktop publishing software.
- May 1986—Auto-trol announced it had integrated the Empress/32 relational data base management system with its Series 5000 and 7000 graphics software.
- January 1986—The Company added a solid modeler to its Series 7000 mechanical design software.
- January 1986—The Company announced an interface between the Series 7000 mechanical software and the ADAMS kinematic analysis program developed by Mechanical Dynamics, Inc.

ORGANIZATION

Personnel Distribution

Personnel are distributed as follows:

Department	Number of Employees
R&D/Engineering	147
Marketing	21
Sales	112
Field Support	160
Administration	57
Other	76
Total Employees	573

Facilities

Auto-trol occupies about 139,000 square feet of space at its headquarters in Colorado, which is used for all operations. In addition, the Company leases approximately 102,000 square feet of space throughout the United States and Canada for domestic sales and service.

MARKETING AND SALES

Strategy

Auto-trol, an early entrant to the CAD industry, offers competitive products in its market segments. The Company was early to market with a distributed workstation and is in the enviable position of having a product line that runs on three major computer operating systems. Despite these strengths, the Company's relatively flat financial performance continues.

Auto-trol's strongest success has been in mechanical applications in U.S. markets. In fact, although the Company is not a market leader in any broad segment, it holds a firm third place in the North American technical workstation-based mechanical CAD market. We believe that Auto-trol has strongholds in oil/petroleum, all fabricated metals, and government markets.

Distribution

The Company sells its products direct from 23 sales offices in the United States, and from sales offices in Australia, Canada, France, Germany, Sweden, and the United Kingdom. Export sales are also handled by independent distributors in Italy, the People's Republic of China, Singapore, South Africa, South Korea, and Taiwan. In addition, in 1986 the Company entered into an agreement with Inacomp Computer Centers for retail sales distribution of its PC-based Advanced Personal Workstations (APLDs).

SALES SUPPORT

Warranties and Maintenance

Auto-trol warrants its systems for 90 days. The Company offers system maintenance on an annual, a monthly, or an on-call basis. Distributors also offer maintenance services, and some hardware maintenance is provided by the manufacturer.

Training

Customer training is offered at the Company's Denver headquarters or at the customer's site on request. Most courses are three to five days long.

STRATEGIC ALLIANCES

Mergers and Acquisitions

In 1985, Auto-trol acquired Tricad and its G3 software, which had been developed with a government agency. G3 forms the basis for Auto-trol's TEAMS telecommunications system design product.

Also in 1985, the Company purchased what had been an R&D limited partnership with a Texas consulting firm for process plant design software known as Vectorpipe.

Joint Developments

Auto-trol's Steel-3D and Foundation-3D product is the result of a joint development with Donald Greenburg of 3D/Eye.

OEM Agreements

Auto-trol began selling computers from Digital Equipment in 1981 and from Apollo Computer in 1982. In addition, the Company has sold IBM personal computers since 1985.

In 1986, Auto-trol announced it will offer the Empress/32 relational data base management system developed by Rhondius Incorporated. This product forms the basis of the Company's EIMS module.

Joint Marketing Agreements

Auto-trol has been a participant in Digital Equipment's System Cooperative Marketing Program for OEMs since 1986.

In 1986, the Company signed a joint marketing agreement for the sale of direct numerical control systems from CIMCO/AIS. Auto-trol will provide an interface from its Series 7000 line to these shop floor products.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- 1985—Auto-trol acquired Tricad, Inc., and its G3 software.
- 1985—The Company acquired its Canadian distributor, ATTC LTD.
- 1985—The Company introduced a PC-based system featuring a 32-bit coprocessor board for its UNIX-based CAD software.
- 1983—The Company announced the Series 5000 graphics software.
- 1983—Auto-trol announced a number of key software modules, including a CSG solid modeler, a B-rep solid modeler, interactive parts nesting, and an interface to PATRAN finite element analysis software.
- 1982—The Company introduced the AGW 32-bit CAD/CAM system based on Apollo technical workstations. This was the first mechanical CAD system to become available on a distributed network.
- 1981—The Company shipped its first VAX-based turnkey mechanical CAD system, based on the newly announced GS-32 software.
- 1979—Auto-trol introduced an electronic technical publications system.
- 1979—Auto-trol introduced electronic technical publishing software.
- 1978—The Company introduced the CC-80 graphics workstation based on storage tube technology.
- 1974—Auto-trol entered the CAD/CAM business as a supplier of digitizers and plotters.

CAD/CAM PRODUCTS

The Company's products are summarized in Table 3. The pages following this table provide a detailed description of each product, with one product per page. These product pages are presented in the order in which they appear in Table 3.

Table 3

Auto-trol Products

Personal Computer-Based Workstations

Model	Manufacturer	Resolution	Description
APW/15	IBM	1,024 X 800	Based on IBM PC AT with UNIX/ graphics board for CAD applications; runs Series 5000 and 7000 software

Technical Workstations

Model	Manufacturer	Resolution	Description
DN3000, DN4000	Apollo	1,280 X 1,024	Runs all Auto-trol software; AEGIS operating system
VAXstation II/GPX, VAXstation 2000	Digital Equipment	1,024 X 864	Runs Series 5000 and 7000 software; MicroVMS operating system

Application Software

Model	Platform	Segment	Description
Series 5000, Core Software	Technical workstation	Facilities design	Includes shading, parametric programming, three-dimensional, drafting, technical publications; runs on Apollo or Digital workstation or APW/15
Series 5000, Building Design	Technical workstation	Facilities design	Modules include PLAN for floor plans, LAYOUTfor layout of office furniture and equipment (including BOM), ELECTRICAL for buildings, and HVAC
Series 5000, Facility Layout/Industrial	Technical workstation	Facilities design	For design and management of manu facturing facilities; includes menu tools for laying out plant equipment and machinery
Series 5000, MOSS	Technical workstation	Mapping	Generates map surface model from survey data input; also includes analysis and manipulation of the model generated; model can be read into Series 5000 for production of construction drawings; runs on Apollo workstation
Series 5000, Steel-3D	Technical workstation	Facilities design	Two- and three-dimensional steel structure design; includes static analysis; runs on Apollo workstation

(Continued)

Table 3 (Continued)

Auto-trol Products

Application Software (Continued)

Model	Platform	Segment	Description
Series 5000, Technical Illustrator	Technical workstation	Mechanical	Drawing and annotation software designed for dedicated technical illustrator; includes optional interfaces to document production hardware, including typesetters, printers, and scanners; runs on Apollo or Digital workstation, or APW/15
Series 5000, Vectorpipe	Technical workstation	Facilities design	Piping design for process plants; includes shading, interference checking, generation of fabrication and construction isometrics; runs on Apollo or Digital workstation
Series 7000, Core Software	Technical workstation	Mechanical	Options include flat pattern, machine and drafting symbols, nesting, interfaces to ADAMS and PATRAN; runs on Apollo or Digital workstation, or APW/15
Series 7000, Die Design	Technical workstation	Mechanical	Die design module; automatic generation ofcross-section views and bills of material; runs on Apollo or Digital workstation, or APW/15
Series 7000, Numeric Control	Technical workstation	Mechanical	Modules include Punching, Flame Cutting,Lathe, Surface Milling, and others; options include COMPACT II and APT source generators, and machine postprocessors; runs on Apollo or Digital workstation, or APW/15
Series 7000, Solid Modeling System	Technical workstation	Mechanical	Solid modeler includes both constructive solid geometry and boundary evaluator; runs on Apollo or Digital workstation, or APW/15
TEAMS	Technical workstation	Mapping	Telecommunications system design; includes G3 (a data base management system), graphics command processor, ATLAS macroprogramming, graphics primitives, and drawing management system; runs on Apollo workstation

(Continued)

Table 3 (Continued)

Auto-trol Products

Other Software

Model	Platform	Type	Description
EIMS/32	Technical workstation	Data base management	Based on Empress/32 relational data base management system from Rhondius; includes Auto-trol user interface; used with both Series 5000 and Series 7000 product lines; runs on Apollo workstation
Ethernet TCP/IP	Technical workstation	Communications	Allows file transfer, terminal emulation, and mail routing among Apollo, Digital, and IBM PC workstations
IGES	Technical workstation	Mechanical	Supports IGES 3.0; includes error handling and diagnostics; runs on Apollo or Digital workstation
Series 5000, Network Manager	Technical workstation	Communications	Provides network manager for Apollo workstations with graphic display of network status; includes RDBMS for network with query capability; runs on Apollo workstation

Source: Dataquest
August 1987

CAD PRODUCT DESCRIPTION

Price: $5000

Model: APW/15
Type: Personal Computer System

System Configuration:

Manufacturer: IBM
Operating System: PC-DOS, UNIX
Communication Protocols: Ethernet
Microprocessor: 80286 Coprocessor: 32032
Word size: 16
4.0 Mbyte main memory included.
60 Mbyte disk memory included.

Workstation Configuration:

Manufacturer: IBM
1024 x 800 resolution. 256 displayable colors

Comments:
Based on IBM PC/AT with UNIX/graphics board for CAD applications. Price range: $5,000 to $19,000. Runs all Auto-trol software

8708-0417-2150 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $10000

Model: DN3000
Type: Technical Workstation System

System Configuration:

Manufacturer: Apollo
Operating System: AEGIS
Communication Protocols: Token ring
Microprocessor: 68020 Coprocessor:
Word size: 32
.4 Mbyte main memory included. Expandable to 8 Mbyte
60 Mbyte disk memory included. Expandable to 358 Mbyte

Workstation Configuration:

Manufacturer: Apollo
1280 x 1024 resolution. Monochrome
Upgrade description: 1024 x 800 16-color display available

Comments:
Price range: 10,000 to $25,000. Runs all Auto-trol software

8788-8417-2649 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $28000

Model: DN4000
Type: Technical Workstation System

System Configuration:

Manufacturer: Apollo
Operating System: AEGIS
Communication Protocols: Token ring
Microprocessor: 68020 Coprocessor:
Word size: 32
4.0 Mbyte main memory included. Expandable to 32 Mbyte
155 Mbyte disk memory included. Expandable to 348 Mbyte

Workstation Configuration:

Manufacturer: Apollo
1024 x 800 resolution. 256 displayable colors

Comments:
Price range: $28,000 to $35,000. Runs all Auto-trol software

0708-0417-3053 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $25000

Model: VAXstation II/GPX
Type: Technical Workstation System

System Configuration:

Manufacturer: Digital Equipment
Operating System: MicroVMS
Communication Protocols: DECnet, Ethernet

Word size: 32
5.0 Mbyte main memory included. Expandable to 16 Mbyte
71 Mbyte disk memory included. Expandable to 159 Mbyte

Workstation Configuration:

Manufacturer: Digital Equipment
1024 x 864 resolution. 16 displayable colors
Upgrade description: 256-color display

Comments:
Includes mouse, tape drive, FPU. Price range: $25,000 to $45,000. Runs all Auto-trol software

0788-0417-0656 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $9000

Model: Vaxstation 2000
Type: Technical Workstation System

System Configuration:

Manufacturer: Digital Equipment
Operating System: MicroVMS
Communication Protocols: DECnet, Ethernet

Word size: 32
6.0 Mbyte main memory included.
71 Mbyte disk memory included. Expandable to 159 Mbyte

Workstation Configuration:

Manufacturer: Digital Equipment
1024 x 864 resolution. Monochrome
Upgrade description: 16-color

Comments:
Price range: $9,000 to $18,000. Runs all Auto-trol software

8708-0417-3314 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $9000

Model: Series 5000, Core software
Type: CAD Application Software for Facilities Design Applications
Hardware Platform: Technical Workstation

CAD Application Software:
two-dimensional, three-dimensional, drafting
technical publications, other design/analysis

Language used: Fortran, C

Prerequisites:
Apollo or Digital workstation or APW/15

Comments:
Includes shading, parametric programming. Price range: 9,000 to $24,000

8708-0417-1424 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $3500

Model: Series 5000, Building Design
Type: CAD Application Software for Facilities Design Applications
Hardware Platform: Technical Workstation

CAD Application Software:
two-dimensional, three-dimensional, drafting
HVAC, architectural, facilities management
electrical

Language used: Fortran

Prerequisites:
Apollo or Digital workstation, or APW/15

Comments:
Modules include PLAN for floor plans, LAYOUT for layout of office furniture and equipment (including BOM), ELECTRICAL for buildings, and HVAC. Price range: $3,500 to $14,000

8786-0418-1388 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $10000

Model: Series 5000, Facility Layout/Industrial
Type: CAD Application Software for Facilities Design Applications
Hardware Platform: Technical Workstation

CAD Application Software:
two-dimensional, three-dimensional, drafting
facilities management

Language used: Fortran, C

Prerequisites:
Apollo or Digital Workstation, Series 5000, Empress/32

Comments:
For design and management of manufacturing facilities; includes menu tools for laying out plant equipment and machinery

8788-0413-3959 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $4800

Model: Series 5000, MOSS
Type: CAD Application Software for Mapping Applications
Hardware Platform: Technical Workstation

CAD Application Software:
contours

Language used: C

Prerequisites:
Apollo workstation

Comments:
Generates map surface model from survey data input. Also includes analysis and manipulation of the model generated. Model can be read into Series 5000 for production of construction drawings. Price range: $4,800 to $18,000

8708-0416-2229 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $6000

Model: Series 5000, Steel-3D
Type: CAD Application Software for Facilities Design Applications
Hardware Platform: Technical Workstation

CAD Application Software:
two-dimensional, three-dimensional, design/analysis
structural

Language used: C

Prerequisites:
Apollo workstation

Comments:
Two- and three-dimensional steel structure design. Includes static analysis. Price range: $6,000 to $20,000

0768-0413-3742 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $7500

Model: Series 5000, Technical Illustrator
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

CAD Application Software:
technical publications

Language used: Fortran, C

Prerequisites:
Apollo or Digital Workstation, or APW/15 and Series 5000

Comments:
Drawing and annotation software designed for dedicated technical illustrator. Includes optional interfaces to document production hardware, including typesetters, printers, and scanners

8708-0410-1732 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $10000

Model: Series 5000, Vectorpipe
Type: CAD Application Software for Facilities Design Applications
Hardware Platform: Technical Workstation

CAD Application Software:
three-dimensional, drafting, design/analysis
piping

Language used: Fortran, C

Prerequisites:
Apollo or Digital workstation, Series 5000, Empress/32

Comments:
Piping design for process plants. Includes shading, interference checking, generation of fabrication and construction isometrics

8708-0410-2059 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $8000

Model: Series 7000, Core software
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

CAD Application Software:
two-dimensional, three-dimensional, drafting
nesting, flat pattern, FEM/FEA
mechanisms/kinematics, other design/analysis

Language used: Fortran, C

Prerequisites:
Apollo or Digital Workstation, or APW/15

Comments:
Options include flat pattern, machine and drafting symbols, nesting, interfaces to ADAMS and PATRAN. Price range: $8,000 to $24,000

8708-0416-5956 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $12500

Model: Series 7000, Die Design
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

CAD Application Software:
two-dimensional, three-dimensional, other manufacturing

Language used: Fortran, C

Prerequisites:
Apollo or Digital workstation, or APW/15; and Series 7000

Comments:
Die design module. Automatic generation of cross-section views and bills of material

8706-8416-1583 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $3000

Model: Series 7000, Numeric Control
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

CAD Application Software:
three-dimensional, solid modeling, numerical control

Language used: Fortran, C

Prerequisites:
Apollo or Digital Workstation, or APW/15; and Series 7000

Comments:
Modules include Punching, Flame Cutting, Lathe, Surface Milling, and others. Options include COMPACT II and APT source generators, and machine postprocessors. Price range $3,000 to $12,000

8708-0416-1130 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $10000

Model: Series 7000, Solid Modeling System
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

CAD Application Software:
solid modeling

Language used: Fortran, C

Prerequisites:
Apollo or Digital workstation, or APW/15; and Series 7000

Comments:
Solid modeler includes both constructive solid geometry and boundary evaluator

8708-0416-1919 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $24000

Model: TEAMS
Type: CAD Application Software for Mapping Applications
Hardware Platform: Technical Workstation

System Configuration:

Operating System: Aegis

CAD Application Software:
utilities

Language used: C

Prerequisites:
Apollo workstation

Comments:
Above price is for G3, a data base management system and graphics command processor. Includes the OBJECT RDBMS, ATLAS macro programming, graphics primitives, and drawing management system. G3 forms basis for TEAMS, a telecommunications system design product

8708-0413-4425 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $3000

Model: EIMS/32
Type: Data Base Management Software
Hardware Platform: Technical Workstation

CAD Application Software:
document management

Language used: C

Prerequisites:
Apollo workstation

Comments:
Based on Empress/32 relational data base management system from Rhondius. Includes Auto-trol user interface. Used with both Series 5000 and Series 7000 product lines

8708-0410-0708 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $1500

Model: Ethernet TCP/IP
Type: Communications Software
Hardware Platform: Technical Workstation

Language used: Fortran, C

Prerequisites:
Apollo, Digital, or APW/15 workstation

Comments:
Allows file transfer, terminal emulation, and mail routing among Apollo, Digital and IBM PC workstations. Price range: $1,500 to $7,500

0700-0410-0055 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $7500

Model: IGES
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

Language used: Fortran, C

Prerequisites:
Apollo or Digital workstation

Comments:
Supports IGES 3.0. Includes error handling and diagnostics

8708-0410-0000 AUTO-TROL

CAD PRODUCT DESCRIPTION

Price: $5000

Model: Series 5000, Network Manager
Type: Communications Software
Hardware Platform: Technical Workstation

CAD Application Software:
three-dimensional

Language used: C

Prerequisites:
Apollo Workstation

Comments:
Provides network manager for Apollo workstations with graphic display of network status. Includes RDBMS for network with query capability

0700-0410-0103 AUTO-TROL

Auto-trol Technology Corporation

THE COMPANY

Background

Auto-trol Technology Corporation was incorporated in 1962 in Denver, Colorado, and held its first public offering of common stock in January 1979. The Company's primary business is the development, manufacture, sales, and service of interactive graphics systems. The Company's computer-aided-design (CAD) products address a broad range of engineering disciplines, including architectural, civil, chemical, electrical, and mechanical engineering.

Highlights

July 1984--Announced an applications package called STEEL-3D that features a new revolutionary screen interface

December 1983--Announced AGW III workstation based on Apollo Computer's DN660 and DN460

September 1983--Announced joint venture with Selenia, an Italian electronics manufacturer, to develop, manufacture, market, and service CAD/CAM systems in Europe

Organization

Auto-trol's corporate facilities are in Denver, Colorado. Located on a 20-acre site, the Company currently occupies 74,000 square feet of space, and has an additional 50,000 square feet of space available for expansion at this site. The Company now employs approximately 600 people. An estimated 30 percent of the work force is engaged in customer support activities, 26 percent in marketing and sales, 20 percent in research and development, and the remaining 24 percent in manufacturing and administration.

Marketing and Sales

Auto-trol generally sells its hardware and licenses the related operating systems and applications software. The Company markets its products directly to end users in North America through 21 sales offices, which report to 3 regional offices.

U.S. sales offices are located in the following cities:

- Atlanta, Georgia
- Buffalo, New York
- Calgary, Canada
- Chicago, Illinois
- Cincinnati, Ohio
- Dallas, Texas
- Denver, Colorado
- Detroit, Michigan
- Houston, Texas
- Los Angeles, California
- Minneapolis, Minnesota
- Newark, New Jersey
- New Orleans, Louisiana
- Norwalk, Connecticut
- Oakland, California
- Philadelphia, Pennsylvania
- Pittsburgh, Pennsylvania
- Seattle, Washington
- Toronto, Canada
- Tulsa, Oklahoma
- Washington, D.C.

Non-U.S. sales are made by a combination of wholly owned subsidiaries and distributors located in the following places:

- Australia
- China
- France
- Germany
- India
- Israel
- Italy
- Singapore
- South Africa

Traditionally, non-U.S. revenue has accounted for 10 to 15 percent of the Company's total revenue. DATAQUEST expects that Auto-trol's presence in the European marketplace will increase due to the Company's recent alliance with Selenia of Italy.

Research and Development

Table 1 illustrates Auto-trol's R&D expenditures as a percent of sales and by dollars per employee. The Company has ranked among the top 15 companies in the United States in both of these categories for the past three years. The large R&D expenditures were incurred as a result of the Company's effort to modernize its product line with newer

Apollo-based workstations known as Advanced Graphics Workstations (AGW). With the bulk of the product line modernization now completed, DATAQUEST believes that Auto-trol is well-positioned to reestablish itself as a major competitive force in the CAD/CAM marketplace.

During 1983, Auto-trol began developing a software product for process plant design via an R&D partnership with Michael Leesley Corporation in Austin, Texas. Michael Leesley is known throughout the CAD community as an authority on plant design and related engineering applications, and served as a key contributor to the efforts made by Compeda and Computervision in this area.

Auto-trol also unveiled a new structural design package at this year's Systems '84 conference. The new STEEL-3D package features a revolutionary screen menu interface developed by Donald Greenburg of Cornell University. STEEL-3D, represents Auto-trol's new R&D direction toward establishing key strategic relationships to develop state-of-the-art products in the CAD/CAM area.

On the hardware front, Auto-trol is continuing to incorporate workstation solutions from Apollo Computer in order to expand its AGW product line. In addition, Auto-trol will begin delivery of its AIP (Advanced Image Processor) and AVP (Advanced View Processor) workstations this year. Both products are Auto-trol-developed extensions to the Apollo computer. They offer advanced shading capability (via Weitek) and increased display interactivity.

Table 1

RESEARCH AND DEVELOPMENT EXPENSES

	1980	1981	1982	1983
R&D Expense*	$6,123	$ 7,956	$ 8,102	$ 8,345
Percent of Revenue	21.1%	17.2%	18.4%	15.4%
Dollars per Employee	$9,277	$14,761	$14,365	$14,413

*Thousands of dollars

Source: Auto-trol Technology Corporation 1983 Annual Report

Manufacturing

Manufacture of Auto-trol's products involves the assembly and testing of parts, printed circuit boards, and major subassemblies provided by OEM sources. Major OEM source and manufacturing relationships are as follows:

- June 1984--Signed agreement valued at more than $1 million with Seiko for color raster hard copy units

- September 1983--Signed agreement with Selenia, an Italian electronics equipment manufacturer, that allows Selenia to develop, manufacture, market, and service Auto-trol's CAD/CAM systems

- August 1982--Entered into an agreement with Raster Technologies for use of monochromatic and color displays in the host-dependent ARW terminal

- December 1981--Entered into a marketing agreement with Digital Equipment Corporation for joint promotion of Auto-trol's software and Digital's VAX-based hardware

- October 1981--Entered into an exclusive joint development and marketing venture with Apollo Computer providing for development of the 32-bit processing unit on which the AGW is based

International Operations

Until the Selenia joint venture agreement, Auto-trol's international operations were limited to sales and marketing activities (see Marketing/Sales). The Selenia agreement, signed in September 1983, provides for the formation of an Italian corporation to be owned 51 percent by Selenia and 49 percent by Auto-trol. The venture will be the sole representative of both Auto-trol and Selenia in the European CAD/CAM market. Initially, the corporation will purchase its hardware products from Auto-trol for resale, together with software contributed by Auto-trol or licensed to the acquired Auto-trol subsidiaries. Over time, the parties expect the venture to develop its own hardware and software to meet the needs of European CAD/CAM users.

Major Historical Milestones

In addition to the milestones already identified in other categories of this profile, the following list identifies numerous other milestones that have occurred throughout Auto-trol's history since its entry into CAD/CAM in 1974:

- October 1983--Announced IGES support
- September 1983--Announced agreement with Catronix for CSG solid modeling software; value of agreement could be as high as $2.5 million over next five years
- June 1983--Showed two workstation projects in development at NCGA to be used for high-performance graphics applications
- June 1983--Introduced B-rep solids modeler called "B-Mod"
- June 1983--Introduced "Auto-Nest," an interactive parts nesting program
- June 1983--Announced licensing arrangement with PDA Engineering for PARTRAN-G finite element modeling software
- June 1983--Announced new desktop workstation called the AGW II based on the Apollo DN300
- March 1983--Formed R&D venture with Michael Leesley Corporation for development of process plant design software
- February 1983--Signed agreement with Raster Technologies valued at $2.5 million over two years for raster terminals
- January 1983--Announced release of Series 5000 software, a 32-bit AEC software package that runs on Apollo and Digital VAX computers
- June 1982--Unveiled the industry's first 32-bit standalone CAD/CAM system based on the Apollo Computer; called the AGW
- January 1982--Acquired 49 percent of Canadian Drafting Systems Ltd., now Auto-trol Technology Limited, the Company's Canadian distributor

- May 1981--Announced GS-32 mechanical software package that runs on Digital Equipment Corporation's VAX line of computers
- 1978--Introduced CC-80 graphics workstation based on storage tube technology
- 1974--Entered turnkey CAD/CAM business as supplier of digitizers and plotters

CAD/CAM PRODUCTS

Auto-trol addresses the needs of a broad range of engineering disciplines with two major product families. The Apollo based (AGW) standalone system has proven to be the most successful for Auto-trol. During 1983, Auto-trol held the lead in marketshare for standalone shipments to the mechanical and AEC marketplace. DATAQUEST estimates that shipments of Auto-trol's AGW workstation products represented 75 to 80 percent of total product shipments during 1983.

The shift Auto-trol has made to a 32-bit environment is also evident in the Company's ARW workstation product, based on Digital Equipment Corporation's VAX-11 family of systems.

Table 2 offers a detailed description of Auto-trol's current product offerings for the CAD/CAM marketplace.

Table 2

AUTO-TROL PRODUCTS

SYSTEMS

Name	Manufacturer	Word Size	Number of Workstations
VAX	Digital Equipment	32-Bit	1-8
AGW II	Apollo Computer	16/32 Bit	1
AGW III	Apollo Computer	32-Bit	1

(Continued)

Table 2 (Continued)

AUTO-TROL PRODUCTS

WORKSTATIONS

Name	Type	Resolution	Number of Colors
ARW	Host-Dependent	19"	1-256
AGW II	Standalone	17"	1
AGW III	Standalone	19"	1-256

BASE SOFTWARE

Name	Mechanical	AEC	PC	IC	EDA	Mapping
Series 5000		X				
Series 7000	X					

APPLICATIONS SOFTWARE

Name	Description
A-Mod	Analytical Solids Modeler--PDA PATRAN-G
APT Interface	Numerical control application for generating APT source files
ATCOMM	Communications package for Apollo, VAX, Sperry, and IBM computers
Auto-Nesting	Automatic nesting of sheet metal components
B-Mod	Boundary Representation Solids Modeler
COMPACT II Interface	Numerical control application for generating COMPACT II output

(Continued)

Table 2 (Continued)

AUTO-TROL PRODUCTS

APPLICATIONS SOFTWARE (Continued)

Name	Description
Finite Element Interface	Design aid used to create finite element models
Flat Pattern Development	Automatic unbending of sheet metal components
ILLUSTRATOR	Architectural design rendering application
MANAGER	Facilities management software licensed from Resource Dynamics Incorporated
Numerical Control	Manufacturing aids package for creating and verifying machine tool motion
PFDS	Plant facility design system for designing plant equipment and piping drawings
PIPING 3-D	Design aid for creating three-dimensional piping models
PLAN	Architectural drafting application
RAP-PID	Creates flow diagrams and process instrumentation drawings
RAP-ISO	Creates isometric drawings and bills of material
RAP-EL	Creates electrical schematics
STEEL-3D	Three-dimensional design system for steel frame structures

Source: Auto-trol Technology Corporation

CADLINC INCORPORATED

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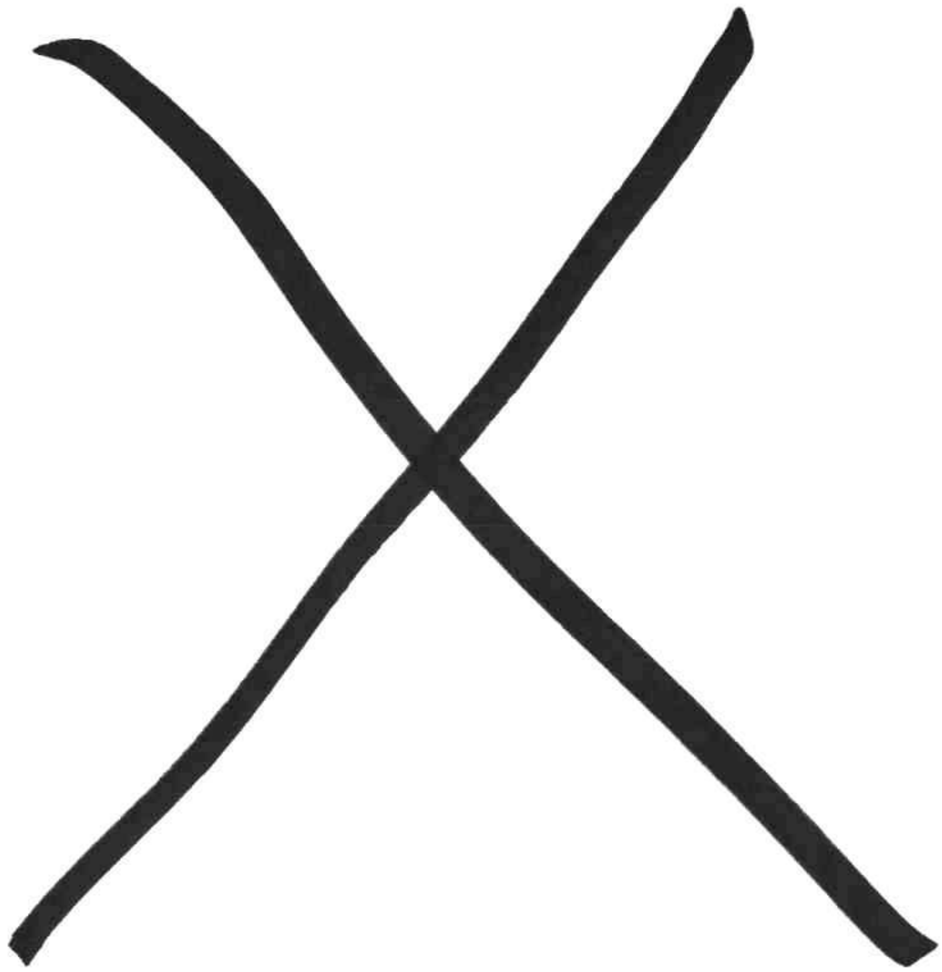
BE REPLACED WITH A PERMANENT TAB SHORTLY



Calay Systems, Inc.

Cadnetix Corporation

CADNETIX CORPORATION

Cadnetix Corporation
5757 Central Avenue
Boulder, Colorado 80301
(303) 444-8075
(Millions of Dollars Except Per Share Data)

Corporate Financial Profile as of June 30

	1982	1983	1984	1985	CAGR 1982-1985
BALANCE SHEET DATA					
Working Capital	$ 1.2	$ 4.9	$10.4	$10.4	103.4%
Long-Term Debt	$ 0.2	$ 0.2	$ 0.7	$ 1.0	69.6%
Shareholders' Equity	$ 1.4	$ 5.3	$11.8	$12.6	108.8%
After-Tax Return on Average Equity	N/A	(61.2%)	(31.8%)	5.8%	
OPERATING PERFORMANCE					
Revenue	$ 0.0	$ 0.0	$ 4.0	$14.1	88.1%
U.S. Revenue	$ 0.0	$ 0.0	$ 4.0	$14.1	88.1%
Non-U.S. Revenue	$ 0.0	$ 0.0	$ 0.0	N/M	
Cost of Goods Sold	$ 0.0	$ 0.0	$ 1.1	$ 3.4	73.1%
Gross Margin	$ 0.0	$ 0.0	$ 2.9	$10.7	93.7%
Expenses	$ 0.3	$ 1.8	$ 5.0	$10.4	244.0%
R&D Expense	$ 0.2	$ 1.1	$ 2.1	$ 3.4	164.8%
SG&A Expense	$ 0.1	$ 0.7	$ 2.9	$ 7.0	356.0%
Operating Income	($ 0.3)	($ 1.7)	($ 2.1)	$ 0.4	N/M
Other Income (Expense)	$ 0.1	$ 0.1	$ 0.3	$ 0.4	99.6%
Income before Tax	($ 0.2)	($ 1.6)	($ 1.9)	$ 0.8	N/M
NOTE: Pretax Margin	N/M	N/M	(46.9%)	5.7%	
Taxes	$ 0.0	$ 0.0	$ 0.0	$ 0.4	N/M
NOTE: Effective Tax Rate	0.0%	0.0%	0.0%	54.8%	
Net Income after Tax	($ 0.2)	($ 1.6)	($ 1.9)	$ 0.4	
SHAREHOLDER DATA					
Average Shares Outstanding (Millions)	1.7	2.3	2.7	11.0	88.1%
Per Share Data					
Earnings	($0.12)	($0.70)	($0.69)	$0.07	N/M
Dividends	$0.00	$0.00	$0.00	$0.00	N/M
Book Value	$0.83	$2.30	$4.36	$1.14	11.0%
TOTAL EMPLOYEES	23	65	138	260	124.4%
Revenue Per Employee	$ 0.0	$ 0.0	$ 0.0	$ 0.1	N/M

N/A = Not Available
N/M = Not Meaningful

Source: Cadnetix Corporation

Cadnetix Corporation
5757 Central Avenue
Boulder, Colorado 80301
(303) 444-8075

Line Items as a Percent of Revenue

	1982	1983	1984	1985
OPERATING PERFORMANCE				
Revenue	N/M	N/M	100.0%	100.0%
United States	N/M	N/M	100.0%	100.0%
Non-United States	N/M	N/M	0.0%	0.0%
Cost of Goods Sold	N/M	N/M	28.4%	24.0%
Gross Margin	N/M	N/M	71.6%	76.0%
Expenses	N/M	N/M	125.1%	73.4%
R&D Expense	N/M	N/M	51.8%	23.8%
SG&A Expense	N/M	N/M	73.4%	49.6%
Other Expense	N/M	N/M	0.0%	0.0%
Operating Income	N/M	N/M	(53.5%)	2.6%
Interest Expense	N/M	N/M	0.0%	0.0%
Interest Income	N/M	N/M	0.0%	0.0%
Other Income (Expense)	N/M	N/M	6.6%	3.1%
Income before Tax	N/M	N/M	(46.9%)	5.7%
Taxes	N/M	N/M	0.0%	3.1%
Net Income after Tax	N/M	N/M	(46.9%)	2.6%

N/M = Not Meaningful

Source: Cadnetix Corporation

THE COMPANY

Background

Cadnetix Corporation of Boulder, Colorado, was incorporated in Colorado on February 4, 1982. The Company designs, manufactures, markets, and services electronic design automation (EDA) and printed circuit board (PCB) computer-aided design (CAD) workstations to automate the design and development of electronic systems. As of December 31, 1985, Cadnetix had systems installed at 170 customer sites.

Highlights

Listed below in reverse chronological order are highlights of the Company's most recent fiscal year:

- February 1986—The Company announced the Route Engine Plus, based on the 68020 microprocessor. Its features include a new multilayer routing algorithm and a 32-bit data path to dual-ported RAM.
- February 1986—Cadnetix announced a joint venture agreement with Excellon Automation, a manufacturer of precision PCB manufacturing products. Under the terms of the agreement, Cadnetix will OEM to Excellon a computer-aided manufacturing (CAM) workstation with image-editing capabilities.
- February 1986—The Company announced the addition of two IBM PC/AT-based software products, the CDX-3100 and the CDX-3150.
- November 1985—Cadnetix made its initial public offering, issuing 2 million shares of common stock priced at $7.00 per share. Goldman, Sachs & Co. and Hambrecht & Quist were the managers of the underwriting group.
- October 1985—The Company announced the CDX-1732 Technical Publications Package (the Q-One word processing package by Quadratron Systems, Inc.), which runs on all of Cadnetix's workstations.
- October 1985—Cadnetix announced the conversion of the Company's product line from the MC 68010 microprocessor to the MC 68020 microprocessor, utilizing a 32-bit data bus to speed operations and move data more quickly. The following products were included:
  - Four new color workstations, designated the CDX-50000S and the CDX-59000S
  - Three new monochrome workstations, designated the CDX-9100S, the CDX-9150S, and the CDX-9200S

— Two new monochrome workstations based on the 86020 microprocessor, the 9300S and the 5900S

- June 1985—The Company introduced the CDX-7900 Modeling Engine, a physical modeler with simulation capabilities, designed to serve as a shared resource for the Company's CDX-9000 series of workstations.

- June 1985—Cadnetix introduced the CDX-77000 Simulation Engine, an accelerator designed to enhance the Cadnetix 9000 Series EDA product line by serving as a network resource in an Ethernet environment.

- June 1985—The Company announced the CDX-79000 Analysis Engine, also designed to enhance the performance of the CDX-9000 Series of workstations with physical modeling and simulation acceleration capabilities.

- April 1985—Cadnetix established its European corporate headquarters in Gloucestershire, England.

- April 1985—At the same time, the Company announced the CDX-75000 routing accelerator for PCB applications.

Organization

Cadnetix's headquarters are located at a 38,000-square-foot facility in Boulder, Colorado. The Company also leases a number of sales offices in the United States. As of February 28, 1986, Cadnetix employed 290 people.

Marketing and Sales

Cadnetix markets its products in North America, Western Europe, and Japan through a direct sales force, foreign subsidiaries, and international distributors. The Company has 15 domestic sales offices in the following states:

- Arizona
- California
- Colorado
- Florida
- Georgia
- Illinois
- Massachusetts
- Minnesota
- New Jersey
- New York
- Texas
- Virginia
- Washington

Cadnetix recently established its European headquarters in Swindon, England, and Munich, West Germany. Cadnetix Ltd., a wholly owned subsidiary, is a full sales and service facility whose territory covers Europe. Saab-Scania Makrodata distributes the Company's products in Scandinavia. Additionally, Cadnetix has signed an agreement with Kanematsu in Japan, whereby Kanematsu will distribute the Company's products in the Far East.

The Company's marketing strategy focuses on accounts with large systems-design operations in such areas as the telecommunications, instrumentation and industrial, aerospace and defense, and computer industries.

Research and Development

Cadnetix's research and product development (R&D) expenditures were $1.1 million in 1983, $2.1 million in 1984, and $3.4 million in fiscal 1985, which ended in June. Cadnetix software engineering is geared toward applications software, network management, and user interface; it represents the bulk of the Company's R&D expense. The Company's hardware development is focused on workstations, servers, and application-specific accelerators.

Training and Support

All of the Company's domestic and international sales offices include full service and support facilities. Cadnetix maintains a one-to-one ratio between field applications engineers and field sales personnel to provide technical support in the sales process and application support.

Although the majority of customer training is done in Boulder, on-site training is available to customers with large installations. Cadnetix includes two training credits with each system purchased. These may be applied to the Company's week-long CAD course covering layout, or to the four-day EDA course. There is also a self-paced EDA tutorial available for use at the customer site.

The Company provides a warranty period of 90 days following installation. After the warranty period expires, Cadnetix offers an annual maintenance contract providing hardware service and software maintenance and updates.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped Cadnetix's past in the CAD/CAM industry:

- June 1984—The Company announced its first electronic design automation products, the CDX-9000 Series of workstations.

- May 1984—Cadnetix introduced the CDX-1721 Ethernet hardware and software package for linking its PCB and EDA workstations products, the CDX-9000 Series of workstations.

- May 1984—The Company completed third-round financing for $8.5 million. Lead investors included Citibank, Kleiner-Perkins, the Mayfield Fund, Robertson-Coleman, and TVI. This brings the Company's total investment to $15.3 million.

- September 1983—The Company's first system, a PCB workstation with schematic capture, automatic place and route, on-line design rules check capabilities, and a manufacturing interface, was installed.

- April 1983—The Company completed its second-round financing for $5.5 million. Lead investors included Kleiner-Perkins, the Mayfield Fund, and TVI.

- February 1982—Cadnetix completed its first round of financing from private sources for $1.5 million.

- February 1982—Cadnetix was founded by Bruce Holland, Steve Koch, and Gary Bliss.

CAD/CAM PRODUCTS

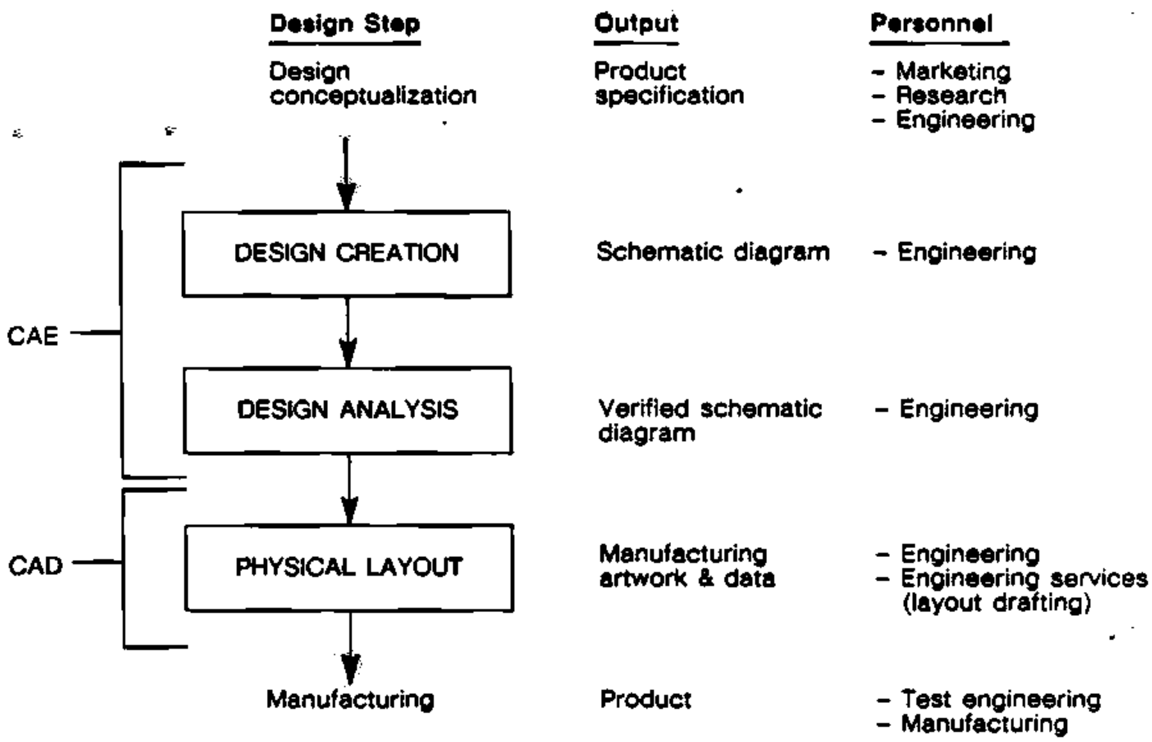
In configuring the Company's product line of workstations and accelerators, Cadnetix views the electronic systems design process as illustrated in Figure 1.

All of the Company's proprietary workstations are based on the Motorola 68000 Series 32-bit microprocessor and have sufficient mass storage and memory to operate as standalone systems; they also may be configured for use with network resources and sharing of design data. All workstations may access design analysis and routing accelerators. The Company recently incorporated the Motorola 68020 microprocessor into most of its products, replacing the 68010.

With the exception of HHB Systems' CADAT logic simulator and the technical publications product from Quadratron Systems, Cadnetix develops its own application software. CADAT is integrated into Cadnetix proprietary software and is packaged with the virtual logic analyzer interface software for operating the simulator. CADAT runs on the special processors as well as the 9200S, 9300S, 5900, and 59000 workstations. For information regarding the role of the Company's various products in the design process, please refer to Figure 2.

Figure 1

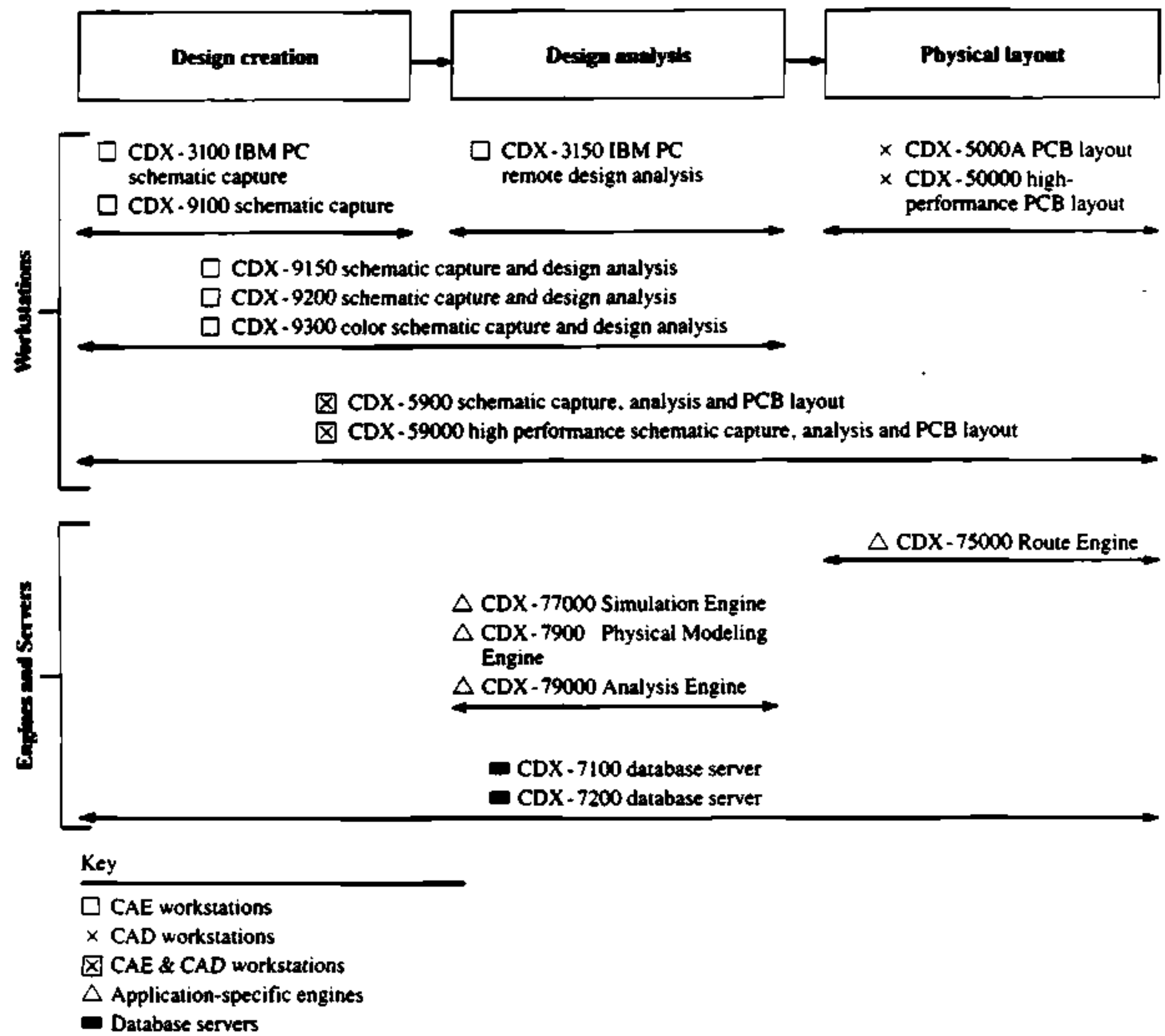
Cadnetix Corporation
Electronic Systems Design Process



Source: Cadnetix Corporation

Figure 2

Cadnetix Corporation
Cadnetix Product Family



Source: Cadnetix Corporation

CALAY SYSTEMS, INCORPORATED

THE COMPANY

Background

Calay Systems, Incorporated, was founded in August 1982 in Irvine, California. The Company develops, manufactures, and markets computer-aided design (CAD) systems for printed circuit board (PCB) design, specializing in routing acceleration. Calay Systems, Incorporated, shares technology and research and development funding with Calay Systems of West Germany, as well as major stock holdings in each company. Otherwise, the companies are separate and independent from each other.

Highlights

The following are recent Calay Systems highlights listed in reverse chronological order:

- January 1986—Calay Systems expanded its sales and technical field-support operations, opening new branches in Chicago, Illinois; Dallas, Texas; Orlando, Florida; and Toronto, Canada. The Company also made additions to its existing facilities in Santa Clara, California, and Boston, Massachusetts.

- December 1985—Calay introduced the Calay ZX100 engineering work-station for schematic capture.

- October 1985—The Company introduced the V04, an upgrade of the V03 PCB CAD system.

- September 1985—Summit Ventures, a Boston-based venture capital group, invested $7 million in Calay and became a minority owner of the Company.

- March 1985—Calay announced a new version of the V03 CAD system for printed circuit boards that includes automatic necking and bending of traces as well as new graphics capabilities such as hardware pan and software zoom.

Organization

Calay maintains its corporate headquarters in Irvine, California, at facilities totaling 82,000 square feet. Research and development, systems integration, sales and marketing, and administrative functions operate out of this facility.

As of January 1986, Calay employed 90 people in North America.

Research and Development

The Company's research and development is located in Irvine, California; Boulder, Colorado; and West Germany. Calay's product development efforts are focused on the automation of the PCB design process.

Marketing and Sales Support

Calay markets its products through a direct national marketing and sales force. The Company has regional offices in Chicago, Illinois; Dallas, Texas; Santa Clara, California; and Wellesley, Massachusetts. Regional offices are full sales and service facilities. The Company's products are sold primarily into the aerospace, defense, and commercial electronics industries. Calay maintains sales offices in the following cities:

- Irvine, California (Customer education center)
- Santa Clara, California
- Toronto, Canada
- Orlando, Florida
- Schaumberg, Illinois
- Gaithersburg, Maryland
- Waltham, Massachusetts (Customer education center)
- Plano, Texas

Training

Calay's customer education program consists of three courses: Board Design, Post-Processing, and Schematic Generation. The Board Design course, one week in duration, covers areas such as hardware system and software management, MGIOS (the Calay design system), auto-routing, net list entry, and routing technologies. The Post-Processing course, three days long, covers areas such as the Calay Editor, drill data preparation and output, and data preparation for post-processing. The Schematic Generation course is two days long and covers schematic generation on the ZX100. Calay's customer education centers are located in Irvine, California, and Waltham, Massachusetts. There are no fees for any of the training courses, regardless of the number of participants in a session.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are some of the events that have shaped Calay's history in the electronics CAD/CAM industry:

- 1982—The Company started in Southern California with three employees, marketing the V03 System.

- 1982—The Calay V03 System was unveiled in West Germany.
- 1980—The first generation of Calay's products, the V01, was installed in Europe.
- 1979—The Calay CAD system was introduced in West Germany.

CAD/CAM PRODUCTS

Calay's product offering is based on an integration of proprietary processor hardware and software with OEM hardware in the Calay V04 CAD workstations and the ZX100 workstations.

Calay's principal product is the V04 workstation for PCB design, using a Digital Equipment Corporation LSI 11/73 and three Calay-proprietary processors that work in parallel with a hardware accelerator. Features include the Calay automatic router as well as automatic placement capabilities with programs designed for handling surface-mount devices. The V04 comes with a color graphics package that allows the user to utilize interactive functions for data preparation, creation of libraries, and reentrant placement or routing changes and modifications.

Based on the LSI 11/23 processor, the RPR-300 is Calay's standalone automatic routing accelerator. The RPR-300 is designed to free the V04 for other interactive work and may be interfaced with other CAD systems.

The ZX100 is Calay's engineering workstation for schematic capture. Based on Texas Instruments' Professional Computer or IBM's personal computer, the ZX100 provides a single schematic data base for on-line design rule checking and instant access to all schematic sheets as well as schematic data transfer link to the Calay V04 featuring forward and backward annotation. Please refer to Table 1 for information on Calay's product offering.

Table 1

Calay Systems, Incorporated
CAD/CAM Products

Model	Platform	Application
V04	DEC LSI 11/73	Printed circuit board
ZX100	IBM PC/AT	Schematic capture
RPR-300	DEC LSI 11/23	Automatic router

Source: DATAQUEST
March 1986

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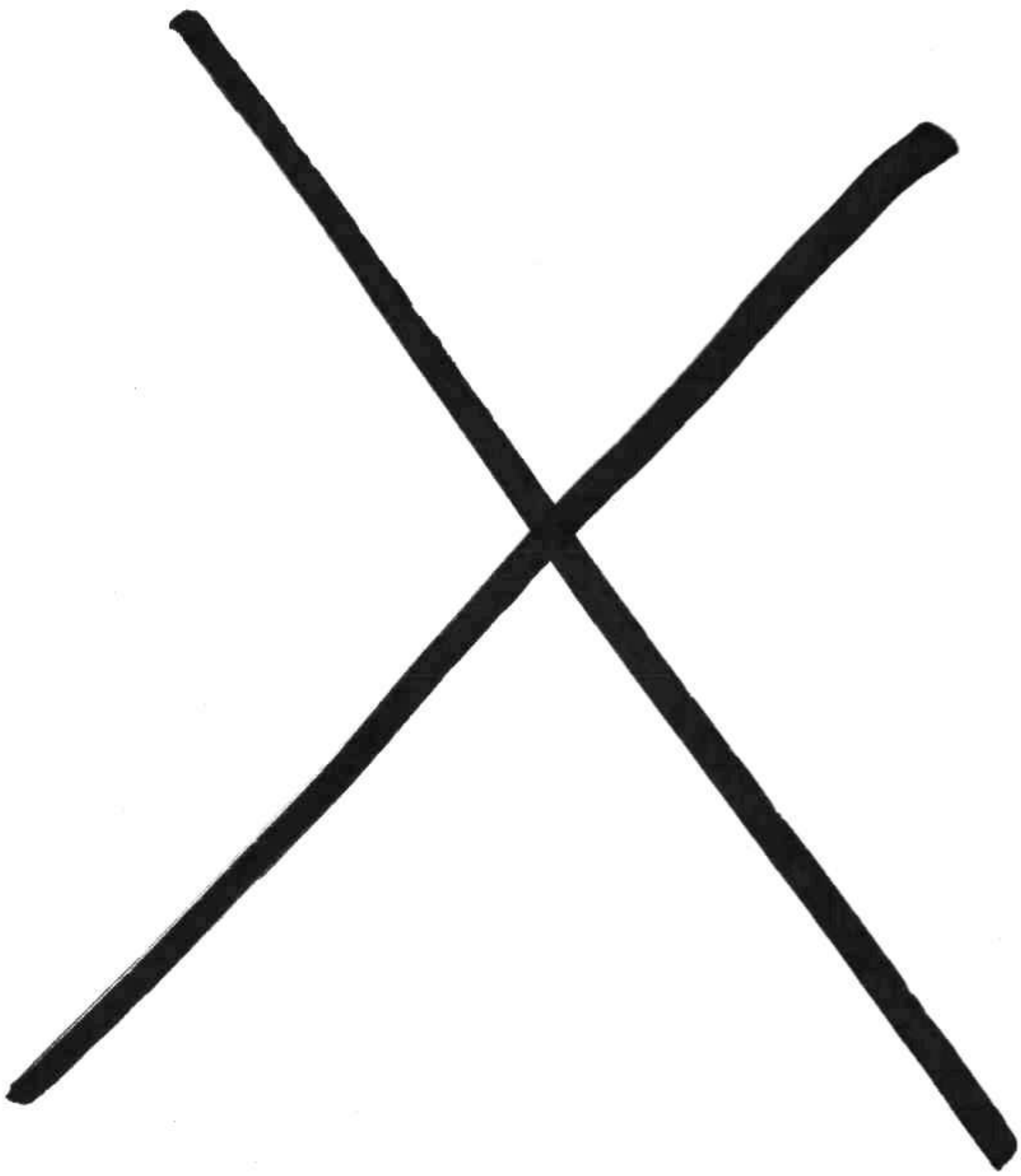

Calma Company

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(Calma is a wholly owned subsidiary; therefore, balance sheet data are unavailable.)

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THE COMPANY

Founded

Calma Company was founded in California in 1964 as a manufacturer of electronic digitizers used in numerous computer applications. In 1981, General Electric Company (GE) acquired Calma from United Telecommunications, Inc., Calma's previous parent company. Calma operates as a wholly owned GE subsidiary.

Positioning

Calma is the leader in the IC CAD segment, although the Company addresses all application segments. Its revenue is primarily derived from IC and mechanical applications. While Calma's principal line of business is the sale and support of turnkey CAD/CAM systems, the Company recently began selling some products as unbundled software.

Calma assembles major system components manufactured by other companies and incorporates its applications software. The software is either developed by Calma's research and development staff or acquired through third-party sources, depending on the specific product.

FINANCIAL

Revenue

Calma is a wholly owned subsidiary of GE; therefore, financial information is not available. Dataquest estimates that Calma's revenue was $183 million in 1985, compared to $204 million in 1984. All of Calma's revenue is derived from CAD/CAM applications. GE's annual report states that Calma sustained a loss in 1985, partially due to a heavy research and development effort.

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- June 1986—Calma announced agreements under which GE Semiconductor and S-MOS Systems, Inc., will offer gate array and standard cell libraries that will run on Calma's Logic Series workstations.
- June 1986—The Company began offering The BOARDS Series PCB design software for Apollo workstations. The BOARDS Series is a repackaging of Calma's former T-BOARDS line.

- June 1986—Calma added windowing to its GDSII IC design system, enabling users to view portions of the physical design concurrently with the entire design.

- June 1986—The Company unveiled several enhancements to its Dimension III three-dimensional AEC software, including:

  - It announced new packages for reinforced concrete and electrical raceway layout and design.

  - An interface was announced between Dimension III and Isogen, an isometric piping drafting package from Imperial Chemical Industries of the United Kingdom.

  - Also announced was an interface between Calma's steel design module and McAuto's STRUDL finite element analysis software.

- April 1986—GE and Calma announced that Calma will offer GE's Graphicon 700 graphics processor. The three-dimensional solids modeling accelerator will be offered for VAX and MicroVAX II-based Calma systems running DDM, I-DEAS, and Dimension III mechanical and AEC software.

- March 1986—The Company introduced the Logic Series EDA software based on Apollo 3000 workstations. The Logic Series is available either bundled or unbundled, and is derived from and replaces the Company's TEGAS product line.

- December 1985—Calma announced a $7.8 million order for Apollo-based CAD/CAM systems for AEC applications from the Peoples Republic of China.

- October 1985—The Company introduced a MicroVAX II-based system that runs DDM, I-DEAS, and Dimension III software.

- October 1985—Calma announced the Draftstation, an IBM PC-based drafting workstation that can communicate with Calma DDM systems. The product will also be marketed in the United States by General Electric's direct sales force.

- July 1985—Calma unveiled an accelerator subsystem for its Fast-Mask Engine system for design rule checking on GDSII systems. The products are supplied by Silicon Systems of Menlo Park, California.

- July 1985—Zycad Corporation and Calma announced a joint agreement to promote Zycad's simulation accelerators. Calma provides an interface to Zycad accelerators in EDA applications.
- January 1985—The Company introduced the GDSII/32 workstation for IC and PCB applications. The unit is based on Data General's 32-bit DS/4200 workstation, and is offered with software similar to the GDSII software that is available for Data General's host computers.

ORGANIZATION

Personnel

250

Calma employs approximately 1,600 people, one-fourth of whom are in R&D.

Facilities

Calma occupies a 575,000-square-foot building at its Milpitas, California, headquarters. This building is used for management, manufacturing, and hardware development. The following locations serve as R&D sites for the Company.

Location	Purpose/Charter
San Diego, California	Data bases; operating systems; mechanical, AEC, and IC applications software
Aptos, California	Silicon compilation
Austin, Texas	EDA and PCB applications software

MARKETING AND SALES

Strategy

Calma has experienced several changes in management and approach since its acquisition by GE in 1981; as a result, the Company's strategy is still evolving. In the last year, Calma has intensified its product development efforts, and in the coming year, the rate of product announcements is expected to increase.

Calma sells products in all CAD market segments. This wide product range permits Calma to offer products that usefully span market segments. For example, the Company is now exploring this potential with its PCB layout product, BOARDS, which interfaces to both its EDA and mechanical design software, thus allowing users to integrate PCB and electromechanical design and layout.

IC Strategy

Leveraging its early leadership in the IC market segment, Calma is now profiting from its position to sell into a large installed base of custom IC CAD systems. However, these installed systems are based on Data General computers that are not widely used in other CAD environments. Recognizing the trend to standardized hardware platforms, Calma offers various CAD systems using Apollo, Digital, and IBM computers, while continuing to reserve Data General-based systems for custom IC layout. The Company's efforts to integrate electronic design solutions are complicated by this substantial core of Data General-based systems users. Calma faces the challenge of expanding its offerings on standard CAD hardware platforms while continuing to satisfy existing IC CAD users.

Calma is steadily moving into application-specific IC (ASIC) CAD markets, and has begun to develop relationships with ASIC vendors such as S-MOS Systems and GE Semiconductor. Through its Logic Examiner software, the Company is also targeting IC testing.

Mechanical and AEC Strategy

Calma offers a full range of mechanical and AEC turnkey products. The Company sells to a broad range of industries and appears to be committed to standard hardware platforms from Apollo, Digital, and IBM. Calma's mechanical and AEC software uses the DAL programming language and can share common hardware.

Calma's parent company, GE, derived a major portion of its 1985 $29 billion revenue from aerospace, aircraft engines, electric power plants and power distribution, factory automation, and transportation equipment. Calma can be expected to continue to develop products that support the manufacturing requirements of these industries in addition to those of the automotive and electronics industries.

In AEC applications, Calma's emphasis continues to be directed toward the design of large plants rather than toward the requirements of small architectural firms. Dataquest believes that the Company's mechanical product focus is on expansion of its core system operation by using solid modeling technology combined with high-performance display technology.

Distribution

Calma distributes its products directly to end users in the United States and Western Europe, and sells both direct and through distributors in other countries.

Locations of Sales Operations

The Company's sales locations are as follows:

- U.S. direct sales offices:
  - Tempe, Arizona
  - Milpitas, California
  - Encino, California
  - Los Alamitos, California
  - San Diego, California
  - Arvada, Colorado
  - Hartford, Connecticut
  - Maitland, Florida
  - Atlanta, Georgia
  - Schaumburg, Illinois
  - Lenexa, Kansas
  - Greenbelt, Maryland
  - Waltham, Massachusetts
  - Southfield, Michigan
  - Minneapolis, Minnesota
  - St. Louis, Missouri
  - Woodbridge, New Jersey
  - Albany, New York
  - Pittsford, New York
  - Raleigh, North Carolina
  - Milford, Ohio

- Portland, Oregon
- Pittsburg, Pennsylvania
- Dallas, Texas
- Houston, Texas
- Bellevue, Washington

• Non-U.S. direct sales offices and representatives:

- Melbourne, Australia
- Sydney, Australia
- Brussels, Belgium
- Sao Paulo, Brazil
- Toronto, Canada
- Vancouver, Canada
- Camberley, England
- Helsinki, Finland
- Nanterre, France
- Israel
- Milan, Italy
- Tokyo, Japan
- Seoul, Korea
- Malaysia
- Gothenburg
- Taiwan
- Frankfurt, West Germany

SALES SUPPORT

Warranties

Calma offers a 90-day warranty on hardware and software.

Maintenance Agreements

The Company offers yearly maintenance agreements for hardware and software.

Training

Calma maintains training centers at its Milpitas, California, headquarters and at the University of Chattanooga in Tennessee. On-site training is also available. Training programs range from one day to two weeks.

STRATEGIC ALLIANCES

Mergers and Acquisitions

In July 1983, Calma purchased a portion of Comsat General Integrated Systems, which resulted in the acquisition of TEGAS software for electronic applications. In March 1986, the Company repackaged TEGAS software as the Logic Series.

Joint Developments

In June 1986, Calma announced agreements under which GE Semiconductor and S-MOS Systems, Inc., will offer gate array and standard cell libraries to run on Calma's Logic Series workstations for EDA applications. These parts libraries will allow Calma users to generate netlists for automatic layout by GE and S-MOS. Calma is also expected to offer physical libraries for its ARRAYS and CellPlus software, which would allow Calma users to do gate array and standard cell layout for manufacture by GE and S-MOS. ARRAYS and CellPlus currently are used principally by ASIC manufacturers for their proprietary designs.

In September 1983, Calma and Quadrex Corporation of Campbell, California, announced the joint development of Viewpipe, a series of software modules for the design and engineering of nuclear power and process plant piping.

GE maintains a nonvoting interest in Structural Dynamics Research Corporation (SDRC), which owns I-DEAS mechanical modeling and analysis software. Before March 1986, GE and SDRC operated a joint venture, CAE International, which marketed and supported SDRC products. The previous CAE International offerings are now sold under the SDRC name. Calma will continue to sell I-DEAS as part of its mechanical offering.

Joint Marketing Agreements

In October 1985, the Company announced that both Calma and General Electric's direct sales forces would market the IBM PC-based Draftstation.

In September 1985, Calma agreed to market the ISOGEN software from Imperial Chemical Industries (ICI). ISOGEN, an isometric piping drafting package, was interfaced to Calma products in cooperation with Fluor Corporation, an engineering firm that uses Calma systems. The product was made available in June 1986.

In July 1985, Zycad Corporation and Calma agreed to jointly promote Zycad's simulation accelerators. Calma's EDA products interface to Zycad's accelerators.

In June 1985, Calma and Meta-Software of Campbell, California, announced a joint marketing agreement whereby both companies will market HSPICE analog circuit simulation software as interfaced to Calma's Apollo-based TEGAStation (now known as the Logic Series). HSPICE will be integrated into Calma's Taskmaster supervisory software.

Calma resells mechanical design and analysis software from SDRC as its I-DEAS product.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- June 1984—Calma introduced T-BOARDS, a system for printed circuit board design, and T-ARRAYS, a system for gate array design, both of which run on the TEGAStation.

- February 1984—The Company announced the TEGAStation, a 32-bit engineering workstation based on Apollo Domain computers and TEGAS electronic software.

- September 1983—Calma and Quadrex Corporation announced the joint development of a series of software modules for the design and engineering of nuclear power and process plant piping.

- July 1983—Calma purchased a portion of Comsat General Integrated Systems, which resulted in the acquisition of TEGAS software for electronic applications.

- 1982—Calma and CAE International, a GE subsidiary, announced a joint product development effort to integrate Structural Dynamics' I-DEAS mechanical modeling and analysis software and Calma's Design, Drafting, and Manufacturing (DDM) core software in a common data base.

- 1982—As the result of a licensing agreement with Moldflow Australia, Ltd., Calma introduced the MOLDFLOW software for analysis of plastic parts and their molds.

- 1982—Calma entered the AEC market with its Dimension III software for P&ID, Piping Design, and Steel Layout.

- 1981—General Electric Company acquired Calma as a wholly owned subsidiary.

- 1978—The Company introduced GDSII, a major upgrade to its core electronic software, which runs on Data General host computers.

- 1977—Calma introduced DDM, its core three-dimensional mechanical CAD software.

- 1971—The Company shipped its first turnkey CAD system for electronic circuit design applications; it used GDSI electronic software.

- 1964—Calma was incorporated and began marketing a line of digitizers.

CAD/CAM PRODUCTS

Market Segment Participation

The Company offers turnkey systems on host-dependent, standalone, and personal computer platforms, and unbundled EDA software. Calma offers products in all CAD/CAM applications.

Product Line

The Company's products are shown in Table 1.

Table 1

Calma Company Products

HARDWARE PLATFORMS

Calma Model	Computer	Product
GDSII/32	Data General 4200	Standalone workstation using Lexidata display with GDSII/32 IC layout software.
(See note)	Digital VAX 11-750 or 11/780	Up to 10 users using Tektronix graphics workstation with ARRAYS or CellPlus IC software; or Calma's graphics proprietary workstation with Dimension III AEC software, DDM, or I-DEAS mechanical software.
(See note)	Digital MicroVAX II	Up to three users using Tektronix graphics workstation with ARRAYS or CellPlus IC software; or Calma's proprietary graphics workstation with Dimension III AEC software, DDM, or I-DEAS mechanical software.
(See note)	Apollo 570A, 660A, 3000	Standalone workstation using Logic Series EDA software, DDM or I-DEAS mechanical software, or Dimension III AEC software.
Draftstation	IBM PC	Drafting system; communicates with DDM systems.

APPLICATION SOFTWARE

Model	Function
Logic Series	EDA software composed of 3 modules: Logic Scribe for schematic capture; Logic Explorer for behavioral, logic, and circuit simulation; and Logic Examiner for fault simulation and interface to test equipment. Runs on Apollo workstations.
GDSII/32	IC layout software. CustomPlus module uses symbolic IC mask editing and provides interface to Logic Series EDA software. TechPlus module is for layout of analog PCBs and hybrids. Runs on Data General computers.
Arrays	IC gate array software. Runs on Apollo workstations and Digital computers.
CellPlus	IC cell-based software. Runs on Apollo workstations and Digital computers.
Boards	Automatic place-and-route PCB software with interface to Logic Series and DDM software. Supports surface-mount design on two sides. Runs on Apollo workstations.
DDM	3-D mechanical design software. Modules available for numerical control, nesting, flat pattern, plastic molds, and design and analysis of dies. Runs on Apollo workstations or Digital's VAX or MicroVAX II.

(Continued)

Table 1 (Continued)

Calma Company Products

APPLICATION SOFTWARE (Continued)

Model	Function
I-DEAS	Mechanical analysis software. Modules include finite element modeling and analysis, solids modeling, kinematics, modal analysis, fatigue analysis, and system dynamic analysis. Runs on Apollo workstations or Digital's VAX or MicroVAX II.
Dimension III	3-D AEC design software. Layout and design modules are offered for steel, piping, HVAC, reinforced concrete, electrical, facilities, and plant equipment. Other modules include architectural drafting, process and instrumentation diagramming, and subterranean modeling. Runs on Apollo workstations or Digital's VAX or MicroVAX II.

APPLICATION-SPECIFIC HARDWARE

Model	Function
Fast Mask Accelerator	IC layout accelerator manufactured by Silicon Systems.
Graphicon 700	High-speed graphics processor manufactured by GE.

Note: Model name is the Calma application software name.

Source: Calma Co.
Dataquest
August 1986

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Calma Company

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(Calma is a wholly owned subsidiary; therefore, balance sheet data are unavailable.)

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Calma Company

THE COMPANY

Background

Calma Company was founded in California in 1964 as a manufacturer of electronic digitizers used in numerous computer applications. In 1971, the company shipped its first turnkey computer-aided-design system for electronic circuit design applications. Calma has since expanded its scope to include a full range of computer-aided design and manufacturing products. In April 1981, General Electric Company (GE) acquired Calma from United Telecommunications, Inc., Calma's previous parent company. Calma operates as a wholly owned subsidiary within the Industrial Electronics Business Group of GE's Technical Systems Sector.

Highlights

During the past year, Calma has continued to broaden its line of CAD/CAM product offerings through internal development, joint development agreements, acquisitions, and a value-added remarketer arrangement.

In September 1983, Calma and Quadrex Corporation announced the joint development of VIEWPIPE, a series of software modules for the design and engineering of nuclear power, and process plant piping.

In July 1983, Calma acquired a portion of Comsat General Integrated Systems, developers of the TEGAS-5 simulation software for printed circuit board and integrated circuit design. The TEGAStation, a 32-bit engineering workstation based on Apollo Domain computers, was announced in February 1984. In June 1984, Calma introduced T-BOARDS, a system for printed circuit board design, and T-ARRAYS, a system for gate array design, both of which run on the TEGAStation.

Calma also introduced two architecture, engineering, and construction (AEC) software packages: Calma-Draft Architecture and Calma-Draft Facilities Layout.

Calma and CAE International, both GE subsidiaries, announced a joint product development effort to integrate Structural Dynamics' I-DEAS mechanical modeling and analysis software and Calma's Design, Drafting, and Manufacturing (DDM) core software in a common data base.

As the result of a licensing agreement with Moldflow Australia, Ltd., Calma now offers the MOLDFLOW software for analysis of plastic parts and their molds.

Calma Company

Calma and IBM reached an agreement in which Calma will incorporate selected IBM products into its product line.

Calma offers the widest array of processors in the CAD/CAM industry. DATAQUEST believes that Calma's system integration strategy can put the Company in a position to gain market share, but Calma must clearly differentiate its product lines both internally and externally, and provide a smooth interface between the different processors.

Operations

Calma designs, manufactures, sells, and supports a full line of CAD/CAM products, addressing the needs of three market segments: mechanical, electronic, and AEC. It assembles major system components manufactured by other companies and adds value to its products by incorporating applications software. The software is either developed by Calma's research and development staff or acquired through third-party sources, depending on the specific product.

Calma sells turnkey systems that are fully functional and ready to use upon delivery. The Company supports its products through its customer support and customer engineering networks.

Calma is a wholly owned subsidiary of GE; therefore, financial information is not available. DATAQUEST estimates that Calma's revenue was $210 million in 1983.

International Operations

Calma's business is conducted on a worldwide basis through its domestic sales offices, international division, distributors, and a joint marketing venture. It maintains offices throughout Europe; the European headquarters are located in Camberley, England. European sales offices are located in Belgium, France, Germany, Italy, and Spain. Distributors are located in Australia, Brazil, Finland, Hong Kong, Israel, Korea, Malaysia, Singapore, Sweden, Switzerland, and Taiwan. Calma has a joint marketing venture with C. Itoh Data Systems located in Tokyo, Japan.

Marketing

Calma sells its systems through a direct sales force in the United States. The U.S. market is divided into four geographic regions: western, southern, central, and eastern. Each region has three district offices. In major market areas, each of Calma's sales representatives is responsible for a single product line and is supported by application engineers who address specific applications.

Organization

Calma is organized into three major divisions: mechanical, AEC, and electronics. The mechanical and AEC divisions' product marketing groups report to the Vice President, Mechanical and AEC Marketing. The electronics division, which includes electronics, communications, DBMS, and system products marketing groups, reports to the Vice President, Electronics Marketing. The product marketing groups are responsible for product definition, marketing, and marketing support.

Calma is located in California and operates out of approximately 450,000 square feet of leased buildings in Santa Clara (headquarters), Sunnyvale (R&D and customer support), and Milpitas (manufacturing). The Company also has an R&D facility in San Diego. DATAQUEST estimates that Calma currently employs approximately 1,800 people.

CAD/CAM BUSINESS

Calma's sole line of business is the sale and support of integrated CAD/CAM systems. Each segment of the market is addressed with a wide array of systems and application software products.

Systems

Calma's systems include:

- Series D--Based on Apollo Domain computers, these systems can be used in an office environment.
- Series P--Based on Data General minicomputers, these systems are for use in large design and drafting centers. Series P systems have special power and environmental restrictions.
- Series C--Based on Digital Equipment's VAX computers, these systems are used for computer-aided analysis, simulation, and other applications that require large amounts of computer power. Series C systems are typically installed in environmentally controlled computer centers.

Calma Company

Applications

To meet the diverse needs of mechanical, electronic, and AEC CAD/CAM users, Calma offers the following three primary application packages.

DDM

Design, Drafting, and Manufacturing (DDM) is a three-dimensional mechanical design software package providing graphic tools for drawing parts, assemblies, and numeric control tool paths. DDM features a high-level user programmable language called DAL (Design Analysis Language). DDM also supports a host of graphics and analysis tools for mechanical engineers or electromechanical engineers. These tools may include finite element modeling, numeric control, NC post processors, printed circuit design, parts nesting, solids modeling, and plastics software.

GDSII

GDSII is the core graphics software upon which Calma's CARDS, CHIPS, and STICKS application packages are based. The CARDS software provides printed circuit board designers with design tools, while CHIPS and STICKS support LSI and VLSI integrated circuit designers. GDSII features a user-programmable language called GPLII. Various design analysis, verification, and output packages are available from Calma. These packages provide electronics engineers and designers with a complete line of CAD/CAM tools.

DIMENSION III

DIMENSION III is a three-dimensional software package providing graphics tools for a wide range of AEC CAD applications. DIMENSION III applications include steel and piping layout and design, process and instrumentation diagrams (P & ID), equipment arrangement, and finite element modeling, as well as mapping, civil site preparation, and subterranean modeling. DIMENSION III features the high-level programmable language DAL.

TEGAStation

TEGAStation is an integrated design system for digital electronics based on the Apollo Domain computer. The station's design capabilities include schematic capture, logic simulation, and analysis. In addition, TEGAStation interfaces with GDSII for logic-to-layout verification through an agreement with ECAD, Inc.

Communications

Calma's line of communications products includes:

- GEnet, a broadband, multiple-access networking system that uses Cable TV (CATV) components

- HYPERchannel, a flexible, high-speed communications system that supports speeds of up to 50 megabits per second

- Calmanet, a communications network system consisting of software designed to function with GEnet, HYPERchannel, and various other hardware used in the communications environment

- DMCS, data management control software

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Cimlinc Incorporated

Cimlinc, Inc.
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(312) 228-7300

THE COMPANY

The Company was founded in 1981 as Cadlinc, Inc. In 1985, Cadlinc changed its name to Cimlinc, Inc. Previous to 1981, a Cadlinc principal was a founder of Systems Associates, Inc. (SAI), a company that had served the automotive market with an extensive library of machine tool post processors. Cadlinc used much of SAI's software in its original product line.

Positioning

Cimlinc sells and supports turnkey systems in mechanical CAD/CAM applications and derives all its revenue from CAD/CAM markets. The Company's performance and market share history are shown in Tables 1 and 2.

Table 1

Cimlinc, Inc.
CAD/CAM Performance
(Millions of Dollars and Actual Units)

	1982	1983	1984	1985	1986
Revenue	$3	$4	$15	$23	$25
Workstations Shipped	0	0	0	397	858
Workstations Installed	0	0	0	397	1,255

Source: Dataquest
June 1987

Table 2

Cimlinc, Inc.
CAD/CAM Market Share History
(Percent of Market Share by Segment)

	1982	1983	1984	1985	1986
All Applications					
Revenue	0	0	0	1%	0
Workstations Shipped	0	0	0	0	1%
Mechanical					
Revenue	0	0	0	1%	1%
Workstations Shipped	0	0	0	1%	1%

Source: Dataquest
June 1987

FINANCIAL

Ownership

Cimlinc is a privately held company; no financial information is available for publication.

Revenue

The Company states that its 1986 calendar year revenue was $25 million.

Financing

Cimlinc has received $24 million of venture capital in four rounds of funding. Investors include Kleiner Perkins Caufield & Byers; Robertson, Colman & Stephens; Concord Partners; Prudential Bache; Hambrecht & Quist; Cowen & Co.; and several international investors.

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- December 1986—The Company announced that it would begin to sell its product line through OEM channels. The first four participants in the OEM program are DEA, LK Tool, GMF Robotics, and Xerox.

- July 1986—Cimlinc announced Power CIM, a new technical workstation line composed of the Modular Machine for office environments and the Machine Manager for factory floor environments. Cimlinc states that the workstations are priced at one-third the cost of the Company's previous systems.

ORGANIZATION

Cimlinc currently has approximately 200 employees. In addition to corporate headquarters in Elk Grove Village, Illinois, the Company has an advanced development group in Menlo Park, California, and an applications development group in Troy, Michigan.

MARKETING AND SALES

Strategy

Cimlinc's competitive advantages include a good working knowledge of the manufacturing process, a wide library of machine tool post processors, and aggressive pricing. The Company has long-time ties to metalworking industries and sells its products primarily to discrete parts manufacturing companies that need to automate their factory processes. Cimlinc emphasizes factory floor links and interfaces to data from other CAD vendors rather than mechanical design and analysis.

The Company manufactures its own line of 68020-based computers; Cimlinc's aim is to make its workstation appear indistinguishable from Sun and Apollo workstations. Although Cimlinc is able to offer a low-cost workstation today, continuing with this approach would require that the Company maintain parity with developments in computer hardware technology—a near impossibility for a small company.

Distribution

Cimlinc distributes its products directly to end users from sales offices in 14 U.S. cities, West Germany, and England. In addition, the Company has a distribution agreement in Scandinavia with Saab.

In 1986, the Company established an OEM distribution channel. The first four participants in the OEM program are DEA and LK Tool (for off-line programming of coordinate measuring machines), GMF Robotics (for off-line robotics programming), and Xerox.

SALES SUPPORT

Maintenance Agreements

Cimlinc offers maintenance agreements on an annual, monthly, or on-call basis—for systems, hardware, or software. The Company offers a plug-in modular component replacement and repair plan, with a guarantee of continuous operation.

Training

Training is offered at Company headquarters in Elk Grove Village, Illinois. Typical training courses are two to three days long.

STRATEGIC ALLIANCES

The Company sells the Empress data base management system from Rhodnius, Inc., and MasterPlan project management software from Unipress Software. In addition, Cimlinc obtained a portion of its software offerings from CAD Centre, of Cambridge, England.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- November 1985—Cimlinc announced the addition of a graphics display for the CIM Machine Manager, a factory floor workstation packaged in a NEMA-12 enclosure.

- November 1985—Cadlinc announced that it changed its name to Cimlinc.

- September 1984—The Company introduced the CIM Factory Manager, a workstation designed for factory floor use.

- June 1982—The Company introduced its first products, known as the Cadlinc Graphic Computer Series, which included the Graphic Computer, Cad-14 Workstation, and Ethernet Graphic Computer.

- June 1982—The Company was founded under the name Cadlinc.

CAD/CAM PRODUCTS

The Company's products are summarized in Table 3. The pages following this table provide a detailed description of each product, with one product per page. These product pages are presented in the order in which they appear in Table 3.

Table 3

Cimlinc Products

TECHNICAL WORKSTATIONS

Model	Manufacturer	Resolution	Description
Power CIM, Machine Manager	Cimlinc, Inc.	1,024 X 792	Includes 11-slot Multibus card cage and floppy drive. Designed for factory floor: meets NEMA-12 standards and includes sealed keyboard, mouse, and cabinet. UNIX 4.3 operating system. For mechanical applications.
Power CIM, Modular Machine	Cimlinc, Inc.	1,024 X 792	Includes 11-slot Multibus card cage and floppy drive. Designed for office environments. Workstation can communicate with wide variety of CAD/CAM and factory machine-tool vendors. UNIX 4.3 operating system. For mechanical applications.

APPLICATION SOFTWARE

Model	Platform	Segment	Description
CIM CAD	Technical Workstation	Mechanical	Functions include solid modeling, drafting, technical publications, numerical control, nesting, flat pattern, mold design/analysis, mechanisms/kinematics, production planning, robotics programming. Runs on Power CIM workstation.
Factory CAD	Technical Workstation	Mechanical	Functions include schematics/diagrams, technical publications, document management, numerical control, mechanisms/kinematics, other manufacturing, production planning. Runs on Power CIM workstation.

OTHER SOFTWARE

Model	Platform	Type	Description
Administrative	Technical Workstation	Data Base Management	Modules include Drawing Office Management (blueprint check in/out), spreadsheet, relational data base, project management. Runs on Power CIM workstation.

Source: Dataquest
June 1987

CAD PRODUCT DESCRIPTION

Price: $20995

Model: Power CIM, Machine Manager
Type: Technical Workstation System for Mechanical Applications

Date of product introduction: 8/86

System Configuration:

Manufacturer: Cimlinc, Inc.
Operating System: UNIX 4.3
Communication Protocols: Ethernet, MAP
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 8 Mbyte at an increase of $3195
86 Mbyte disk memory included.

Workstation Configuration:

1024 x 792 resolution. Monochrome

Prerequisites:
IM software

Comments:
Includes 11-slot Multibus card cage and floppy drive. Maintenance: $335 per month. Designed for factory floor: meets NEMA-12 standards, and includes sealed keyboard, mouse, and cabinet

8705-0609-5655 CIMLINC

CAD PRODUCT DESCRIPTION

Price: $12995

Model: Power CIM, Modular Machine
Type: Technical Workstation System for Mechanical Applications

Date of product introduction: 8/86

System Configuration:

Manufacturer: Cimlinc, Inc.
Operating System: UNIX 4.3
Communication Protocols: Ethernet
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 20 Mbyte at an increase of $12780
86 Mbyte disk memory included. Expandable to 1200 Mbyte at an increase of $26280

Workstation Configuration:

1024 x 792 resolution. 256 displayable colors
Upgrade description: monochrome display is $5,000 less

Prerequisites:

CIM software

Comments:

Includes 11-slot Multibus card cage and floppy drive. Maintenance: $335 per month. Designed for office environments. Workstation can communicate with wide variety of CAD/CAM and factory machine-tool vendors

0705-0609-5653 CIMLINC

CAD PRODUCT DESCRIPTION

Price: $4495

Model: CIM CAD,
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

CAD Application Software:
solid modeling, drafting, technical publications
numerical control, nesting, flat pattern
mold design/analysis, mechanisms/kinematics, production planning, robotics programming

Language used: C

Prerequisites:
Power CIM workstation

Comments:
Modules include CIM CAD drafting, $4,495; CIM CAM NC, $6,495; CIM SURF Surfaces NC programming, $6,495; CIM SOLID, $3,495; CIM Intelligent Documentation, $3,995; Avatar parametric design, $2,995; Ethernet link, $1,495 ; SNA 3270 link, $12,495; and IGES, $7,995. Links to other vendors available

8705-0610-5801 CIMLINC

CAD PRODUCT DESCRIPTION

Price: $1995

Model: Factory CAD
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

CAD Application Software:
schematics/diagrams, technical publications, document management
numerical control, mechanisms/kinematics, other manufacturing
production planning

Prerequisites:
Power CIM workstation

Comments:
Modules include Factory CAD (view only), $1,995; FACTORY CAM NC cutter preview; Factory Intelligent Documentation (view only), $1,995; and DNC NC program download

8705-0611-0640 CIMLINC

CAD PRODUCT DESCRIPTION

Price: $4995

Model: Administrative
Type: Data Base Management Software for Mechanical Applications
Hardware Platform: Technical Workstation

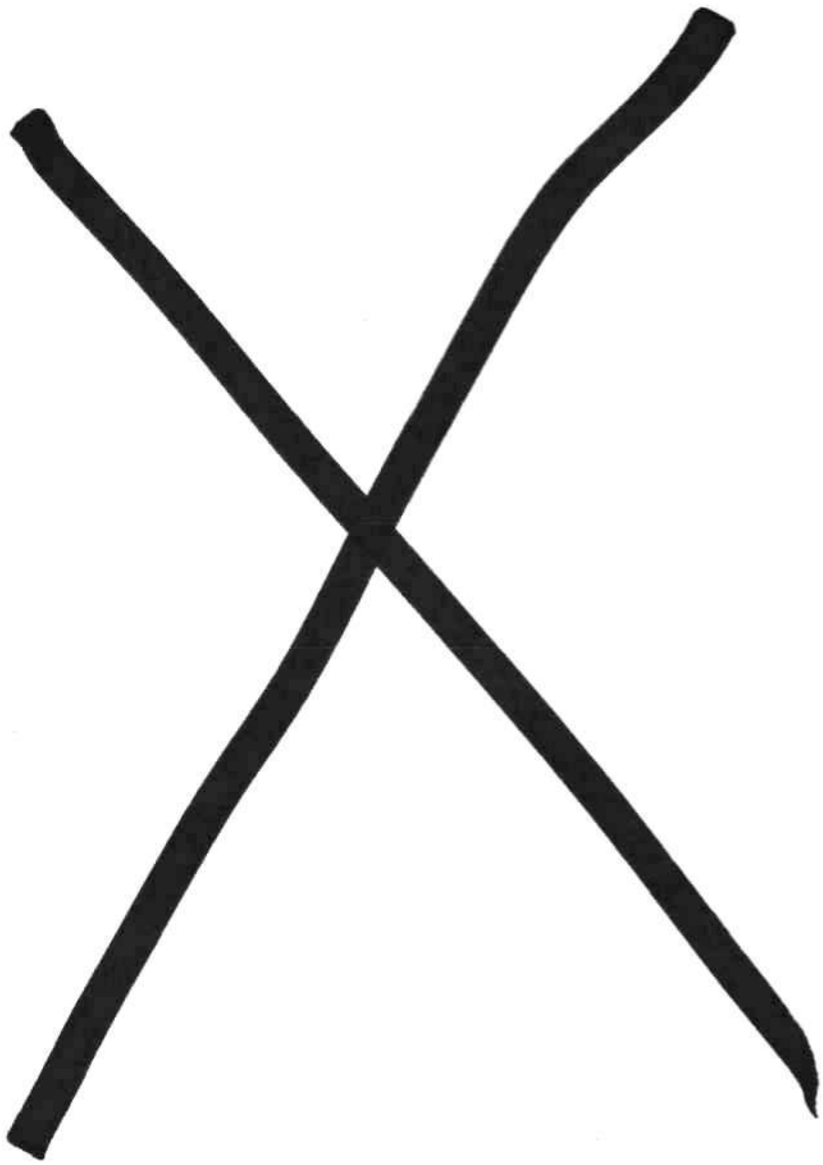
CAD Application Software:
technical publications, document management, production planning

Language used: C

Prerequisites:
Power CIM workstation

Comments:
Modules include Drawing Office Management (blueprint check in/out), $4,995; spreadsheet, $495; relational data base, $2,495; and project management, $495

8705-0611-0939 CIMLINC



Computervision Corporation

Computervision Corporation
201 Burlington Road
Bedford, Massachusetts 01730
Telephone: (617) 275-1800

Corporate Financial Profile as of December 31
(Millions of Dollars Except Per Share and Employee Data)

	1981	1982	1983	1984	1985	CAGR 1981-1985
Balance Sheet Data						
Working Capital	$ 80.7	$ 93.4	$ 80.8	$ 186.5	$ 136.6	14.1%
Long-Term Debt	$ 13.9	$ 12.9	$ 31.9	$ 34.0	$ 34.5	25.5%
Shareholder's Equity	$ 145.0	$ 179.8	$ 220.0	$ 186.2	$ 263.4	16.1%
After-Tax Return on Average Equity	25.1%	19.9%	17.7%	20.4%	(35.9%)	
Operating Performance						
Revenue	$ 270.7	$ 325.2	$ 400.0	$ 556.3	$ 441.1	13.0%
U.S. Revenue	$ 147.0	$ 177.2	$ 208.0	$ 380.1	$ 310.8	20.6%
Non-U.S. Revenue	$ 123.8	$ 148.0	$ 192.0	$ 176.2	$ 130.3	1.3%
Cost of Goods Sold	$ 109.8	$ 147.2	$ 185.5	$ 255.8	$ 287.4	27.2%
Gross Margin	$ 160.9	$ 178.0	$ 214.5	$ 300.5	$ 153.7	(1.1%)
Expenses	$ 105.6	$ 129.8	$ 160.5	$ 226.0	$ 226.3	21.0%
R&D Expense	$ 27.1	$ 36.3	$ 43.7	$ 60.9	$ 61.6	22.8%
SG&A Expense	$ 78.4	$ 97.7	$ 119.6	$ 165.9	$ 162.6	20.0%
Other Income (Expense)	$ 0.1	($ 4.2)	($ 2.8)	($ 0.8)	$ 2.1	120.8%
Operating Income	$ 55.3	$ 48.2	$ 54.0	$ 74.5	($ 72.6)	N/M
Interest Expense	($ 2.5)	($ 2.6)	($ 4.0)	($ 7.3)	($ 16.2)	59.6%
Interest Income	$ 5.9	$ 3.9	$ 3.5	$ 2.5	$ 2.3	(20.9%)
Other Income (Expense)	0.0	0.0	0.0	0.0	($ 41.3)	N/M
Income before Tax	$ 58.8	$ 49.5	$ 53.5	$ 69.7	($ 127.8)	
Note: Pretax Margin	21.7%	15.2%	13.4%	12.5%	(29.0%)	
Taxes	$ 23.0	$ 17.1	$ 22.0	$ 22.0	($ 47.0)	N/M
NOTE: Effective Tax Rate	39.1%	34.6%	34.0%	31.6%	N/M	
Extraordinary Loss*	($ 4.0)	0.0	0.0	($ 10.0)	0.0	
Extraordinary Gain**	0.0	0.0	0.0	$ 3.7	0.0	
Net Income after Tax	$ 31.8	$ 32.4	$ 35.3	$ 41.4	($ 80.8)	N/M
Shareholder Data						
Average Shares Outstanding (Millions)	27.5	27.5	28.3	28.7	28.8	1.2%
Per Share Data						
Earnings	$ 1.30	$ 1.18	$ 1.24	$ 1.44	($ 2.82)	N/M
Dividends	0.0	0.0	0.0	0.0	0.0	0.0
Book Value	$ 5.27	$ 6.54	$ 7.77	$ 6.49	$ 9.14	14.7%
Price Range (Low) (High)	$ 26 1/8- 49 3/8	$ 27 1/8- 37 5/8	$ 37 1/8- 47 5/8	$ 29.00- 46 1/4	$ 9 1/4- 44 1/4	
TOTAL EMPLOYEES	3,800	4,130	5,070	6,530	4,700	5.8%
Revenue Per Employee	$71,239	$78,737	$78,902	$85,198	$92,482	6.7%

*Losses are from writedown of discontinued operation of the Cobilt Division in 1981 and of the Metheus-CV joint venture in 1984.
**Gain is from Prime Computer's purchase of joint interest in MEDUSA.
N/M = Not Meaningful

Source: Computervision Corporation
Dataquest
October 1986

Computervision Corporation
201 Burlington Road
Bedford, Massachusetts 01730
Telephone: (617) 275-1800

Corporate Financial Profile as of December 31
(Millions of Dollars Except Per Share and Employee Data)

Line Items as a Percent of Revenue

	1981	1982	1983	1984	1985
Operating Performance					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	54.3%	54.5%	52.0%	68.3%	70.5%
Non-United States	45.7%	45.5%	48.0%	31.7%	29.5%
Cost of Goods Sold	40.6%	45.3%	46.4%	46.0%	65.1%
Gross Margin	59.4%	54.7%	53.6%	54.0%	34.9%
Expenses	39.0%	39.9%	40.1%	40.6%	51.3%
R&D Expense	10.0%	11.2%	10.9%	10.9%	14.9%
SG&A Expense	29.0%	30.0%	29.9%	29.8%	36.9%
Other Expense	0.0	(1.3%)	(0.7%)	(0.1%)	0.5%
Operating Income	20.4%	14.8%	13.5%	13.4%	(16.4%)
Interest Expense	(0.9%)	(0.8%)	(1.0%)	(1.3%)	(3.7%)
Interest Income	2.2%	1.2%	0.9%	0.4%	0.5%
Other Income (Expense)	0.0	0.0	0.0	0.0	(9.4%)
Income before Tax	21.7%	15.2%	13.4%	12.5%	(29.0%)
Taxes	8.5%	5.3%	4.5%	4.0%	(10.7%)
Net Income after Tax	11.7%	10.0%	8.8%	7.4%	(18.3%)

Source: Computervision Corporation

THE COMPANY

Founded

Computervision Corporation was incorporated in Massachusetts in 1969. In 1975, the Company reincorporated in Delaware.

Positioning

Computervision derives all of its revenue from CAD/CAM products. The Company primarily sells and supports turnkey systems on host-dependent, standalone, and personal computer platforms; it also sells software for personal computers. The Company serves six major industry groups: automotive; aerospace; fabricated materials; mechanical machinery; electrical/electronics; and architecture, engineering, and construction.

Computervision led the CAD/CAM market in revenue until 1983, but it has since moved to third place following IBM and Intergraph. While the Company's personal computer and technical/standalone workstation revenue increased in 1985, the increase was not enough to make up for a dramatic drop in revenue from host-dependent systems. Computervision's CAD/CAM performance and market share history are shown in Tables 1 and 2.

Table 1

Computervision Corporation
CAD/CAM Performance
(Millions of Dollars/Actual Units)

	1981	1982	1983	1984	1985
Revenue	$271	$325	$400	$556	$441
Workstations Shipped	2,515	2,794	2,678	2,522	4,794
Workstations Installed	6,613	8,989	11,208	13,071	14,497

Source: Dataquest
September 1986

Table 2

Computervision Corporation
CAD/CAM Market Share History
(Percent Market Share by Segment)

	1981	1982	1983	1984	1985	1985 Rank in Market
All Applications						
Revenue	27%	23%	19%	16%	19%	3
Workstations Shipped	35%	26%	16%	4%	5%	2
Mechanical						
Revenue	28%	21%	22%	21%	11%	2
Workstations Shipped	35%	26%	18%	6%	7%	2
AEC						
Revenue	28%	24%	16%	8%	7%	2
Workstations Shipped	31%	21%	14%	2%	3%	2
Mapping						
Revenue	18%	15%	4%	3%	2%	4
Workstations Shipped	35%	24%	5%	3%	2%	3
EDA						
Revenue	0	0	0	0	2%	7
Workstations Shipped	0	0	0	0	2%	4
IC						
Revenue	13%	17%	7%	9%	9%	4
Workstations Shipped	19%	22%	10%	6%	9%	3
PCB						
Revenue	42%	38%	30%	20%	11%	1
Workstations Shipped	43%	38%	22%	9%	7%	2

Source: Dataquest
September 1986

FINANCIAL

Computervision's only public offering occurred in December 1972. Net proceeds to the Company were $6.57 million.

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- June 1986—Computervision introduced the AEC portion of CADDS 4X software running on the CADDStation technical/standalone workstation.

- May 1986—The Company demonstrated the CADDStation family of technical/standalone workstations, based on products from Sun Microsystems. The CADDStation line features 32-bit workstations (designated Model 32), which run UNIX-based CADDS 4X software. This line also incorporates the Series 3000 16-bit workstations (designated Model 31), which can access UNIX-based CADDS 4X software.

- April 1986—Computervision began offering its MEDUSA mechanical application software on Digital's VAXstation II/GPX, which is based on the MicroVAX II processor. At the same time, the Company stopped offering MEDUSA on the Sun-based CDS-3000.

- March 1986—The Company announced Autoboard PCB layout software for the CADDStation.

- November 1985—The Company announced the Personal Machinist, a PC-based 2.5-axis numerical control package.

- September 1985—Computervision announced availability of MEDUSA on Digital's MicroVAX II. The Company also introduced two CAD host-dependent workstations for the MicroVAX II—the WS35 and WS45.

- June 1985—The Company introduced the Personal Engineer, an IBM PC AT-based schematic capture package. In August 1985, Computervision announced additional software for the Personal Engineer: HILO-3 digital simulation and SPICE analog simulation.

- April 1985—Computervision announced the integration of DADS (Dynamic Analysis and Design System) mechanical analysis software on the CDS 4000. Developed by CADSI of Oakdale, Iowa, DADS offers 2-D and 3-D kinematic, dynamic, and static equilibrium analysis. The DADS package is an addition to Computervision's third-party kinematic and dynamic analysis offerings, which include ADAMS and DRAM.

ORGANIZATION

Personnel Distribution

As of September 1986, Computervision employed approximately 4,500 persons. Personnel are distributed as follows:

Department	Percentage of Employees
R&D/Engineering	13%
Marketing	3%
Manufacturing	21%
Sales	13%
Field Services	33%
Corporate Administration	12%
Personal Systems Business Unit (PC Products)	2%
CIS Business Unit (MEDUSA Products)	3%

Facilities

Computervision occupies 1,965,000 square feet of space throughout the world, including 1,019,000 square feet at its Bedford, Massachusetts, headquarters; 498,000 square feet in 25 other states; and 448,000 square feet in non-U.S. countries. Of the Company's total square footage, 571,500 square feet are allocated to manufacturing, primarily in the Bedford area.

MARKETING AND SALES

Strategy

Historically, the Company has offered its CAD software on its proprietary host computers. In recent years, this strategy contributed to poor results, and Computervision moved to offer its software on standalone and personal computer platforms based on Sun processors and IBM PCs. Computervision's current strategy focuses on enhancing its solid modeling products and supporting recognized industry standards. The Company has ported most of its proprietary CAD software to the UNIX-based CADDStation, a standalone workstation that contains a processor board, memory board, and bus from Sun Microsystems. However, the Company has also incorporated a significant amount of non-Sun hardware into the CADDStation.

This strategy may offer Computervision the best of two worlds. The Company can justifiably claim to offer the most important feature of "standard" hardware: a recognized independent source. That is, buyers anticipate that they will be offered advances in computer and communications technologies developed by an independent computer manufacturer, Sun Microsystems. At the same time, since Computervision's UNIX-based software runs only on the CADDStation, the Company can avoid being pushed toward unbundled software sales—a trend that is eroding the profit margins of competitors.

Computervision's product-development agreement with Sun Microsystems is an important component of its plans to shift sales to the CADDStation. The agreement covers "an exchange of technologies, cooperation in future product development, and joint manufacturing of intelligent workstation products." This broad agreement provides the Company with Sun's cooperation in porting Computervision CAD software to the Sun-based workstation. Computervision will likely also benefit from communications capabilities inherent in the Sun product line—e.g., Sun's Network File System (NFS), TCP/IP, and the Ethernet local area network.

Sun's vantage point is worth noting here. Sun's NFS, a machine-independent file access scheme, represents a continuation in the development of industry-standard communications protocols on the UNIX operating system. Prior to creating NFS, a Sun cofounder headed development of UNIX 4.2, a version of UNIX that incorporated both the TCP/IP protocols and a convenient interface to Ethernet. Sun's engineering strengths in networking and communications should give Computervision a significant boost in implementing communications across Computervision product lines.

We believe that Computervision's short-term results depend on the following:

- Continued revenue from the Company's large installed base on the host-dependent CDS 4000
- Market acceptance of the new CADDStation system
- Successful completion of the porting of host-dependent CAD software to the CADDStation
- Enhanced networking across Computervision product lines

Distribution

The Company's PC-based products are sold primarily through a network of distributors and by the Company's own sales force. Other Computervision products are sold directly in North America and both directly and through distributors on other continents.

Locations of Sales Operations

The Company maintains sales locations in 30 U.S. cities and in approximately 20 other countries. Computervision sells its CADDStation and CDS 4000 line through distributors in fewer than 5 non-U.S. countries. The Company's personal computer products are sold through a network of distributors throughout the world.

SALES SUPPORT

Warranties

Computervision offers a 90-day warranty on hardware and software.

Maintenance Agreements

Computervision offers hardware and software maintenance at a fixed monthly charge. In addition, the Company offers a variety of services on an on-call basis.

Training

The Company offers training at centers in Massachusetts, California, Illinois, and Texas, or at the customer's site on request. Training courses are typically one to two weeks long.

STRATEGIC ALLIANCES

Mergers and Acquisitions

In 1983, The Company acquired Organization for Industrial Research (OIR) of Waltham, Massachusetts, makers of group technology and process planning software. Computervision offers OIR software on both the CDS 4000 and the CADDStation.

Computervision acquired Grado Software of Munich, West Germany, in 1983. Grado, the source of the Company's PCB layout software, now functions as a Computervision R&D facility.

In 1982, the Company bought Cambridge Interactive Systems (CIS), the maker of MEDUSA CAD/CAM software. Computervision sells MEDUSA on VAX-based systems from Digital Equipment Corporation.

Computervision sold a joint-ownership interest in MEDUSA to Prime Computer, Inc., in 1984. Under this agreement, Prime sells, maintains, and develops MEDUSA on its own computers.

Joint Developments

Computervision and Sun Microsystems maintain an agreement, signed in 1983, that covers an exchange of technologies, cooperation in future product development, and joint manufacturing of intelligent workstation products. Under the agreement, Sun also supplies workstation hardware and software to Computervision and has access to Computervision's field support facilities and services.

In 1984, Computervision and Metheus Corporation announced the formation of a joint venture—designated Metheus-CV—to design, develop, and market electronic design automation (EDA) products. As a result of continuing losses, Computervision wrote off its $10 million investment in the venture. By the end of 1986, the Company expects to assimilate Metheus-CV activities and dissolve the joint venture.

OEM Agreements

Computervision is a value-added dealer for IBM personal computers and has an agreement as a value-added reseller for the IBM 43XX host computer. The PDM data base management system was formerly sold, bundled with the 43XX host, as the CDS 5000. At this time, however, Computervision sells PDM as unbundled software and does not actively sell the 4300 computer.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- June 1984—Computervision and Metheus announced the formation of a joint venture to design, develop, and market electronic design automation (EDA) workstation products. The new company was called Metheus-CV.

- June 1984—Computervision reported a $3.7 million gain on its sale of a software joint-ownership interest in MEDUSA to Prime Computer, Inc.

- 1984—The Company introduced the CDS 5000 product based on the IBM 4300, the CDS 3000 products based on processors from Sun Microsystems, and the CDS 4000 proprietary host computers.

- September 1983—Computervision announced an agreement with Sun Microsystems for the joint development and manufacture of standalone engineering workstations. This arrangement later evolved to form the basis of what was known as the CDS 3000 product line and is now called the CADDStation Systems line.

- July 1983—The Company acquired Organization for Industrial Research (OIR) of Waltham, Massachusetts, makers of group technology and process planning software.

- June 1983—Computervision acquired Grado Software of Munich, West Germany, developers of PCB layout software.

- November 1982—Computervision bought Cambridge Interactive Systems (CIS), the maker of MEDUSA CAD/CAM software.

- 1979—Company stock (CVN) was traded for the first time on the New York Stock Exchange.

- 1972—Computervision had its initial public stock offering.

- 1971—The Company installed its first systems.

- 1969—Computervision was incorporated.

CAD/CAM PRODUCTS

Market Segment Participation

Computervision primarily sells and supports turnkey systems on host-dependent, standalone, and personal computer platforms and sells software for personal computers. The Company offers products for mechanical, AEC, mapping, EDA, and PCB applications. We expect IC layout software, which was offered in the past, to be announced in the future for the CADDStation line.

Product Line

Computervision's principal products include the following:

- Proprietary CDS 4000 host computers running CADDS 4X software under the CVMOS operating system (Designs may be transferred between the CDS 4000 and a CADDStation over an Ethernet local area network.)

- CADDStation standalone workstations running UNIX-based CADDS 4X or electronic software (These workstations are manufactured by Computervision and incorporate a processor board, memory board, and bus manufactured by Sun Microsystems; and graphics processing products from Weitek.)

- Personal Series software or systems using the IBM PC AT or XT (A CDS 4000 terminal emulation package is available, and users can upload a design to the CDS 4000 host.)

- Bundled or unbundled MEDUSA mechanical software for users who require VAX or MicroVAX hardware

The Company's products are listed in Table 3.

Table 3

Computervision Corporation Products

PERSONAL COMPUTER-BASED WORKSTATIONS	
Platform	**Description**
IBM PC AT or PC XT	Personal Series software, graphics display, and input device added to an IBM PC; turnkey models known by software model names (e.g., Personal Designer); personal computer products sold as turnkey systems, as personal computer upgrades, or as software only
STANDALONE WORKSTATIONS	
Model	**Description**
CADDStation Model 32	UNIX-based workstation that uses Sun Microsystems' products for mechanical, AEC, mapping, EDA, and PCB applications
HOST COMPUTERS	
Product	**Description**
CADDServer	Multiuser version of CADDStation for up to six users; supports Sun's NFS, a device-independent file access scheme
CDS 4000	Proprietary 32-bit computer for up to 18 CAD users; runs Computervision software for mechanical, AEC, mapping, EDA, and PCB applications
Designer V-X	Precursor to the CDS 4000 for up to 8 users; can be upgraded to a CDS 4000
Digital VAX and MicroVAX	Used with MEDUSA software

(Continued)

Table 3 (Continued)

Computervision Corporation Products

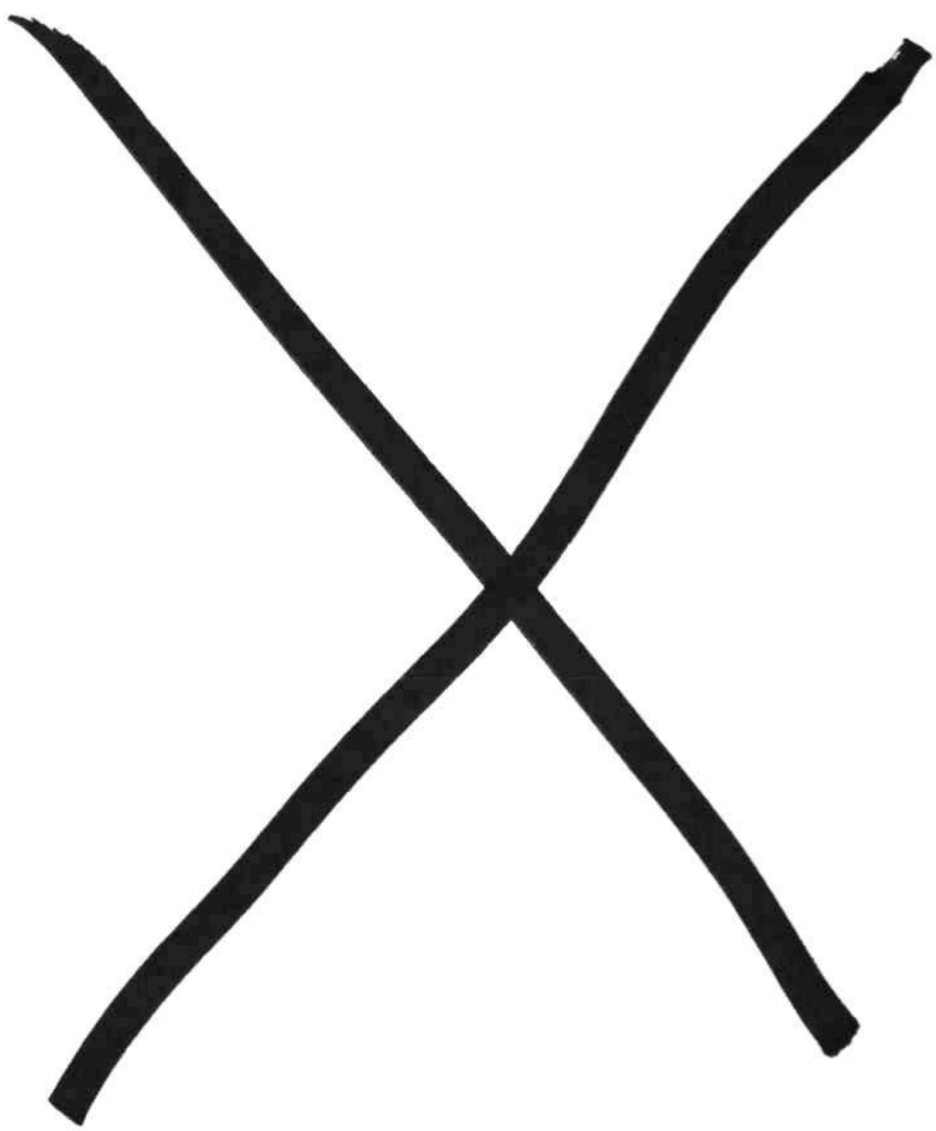
HOST-DEPENDENT WORKSTATIONS

Model	Description
Instaview	For use with CDS 4000 and Designer V-X systems and has 1,280 x 1,024 resolution display
WS45, WS35	Used with VAX and MEDUSA; based on products from Tektronix; have 1,280 x 1,024 resolution display
CADDStation Model 31	Can access UNIX-based Model 32 CADDStations or operate as a CDS 4000 host-dependent workstation; was formerly known as the CDS 3000

APPLICATION SOFTWARE

Product	Description
CADDS 4X (Computervision Automated Design and Drafting System)	Mechanical, AEC, and mapping software originally written for Computervision's proprietary host computers and now available for the CADDStation family; solid modeling functions not yet available for CADDStation
Electronics Applications; Autoboard	EDA and PCB software available to both the CDS 4000 and the CADDStation; IC layout software, previously available for the CDS 4000, anticipated for the CADDStation
MicroCADDS	Subset of CADDS 4X running on the Personal Designer; includes 2-D drafting and 3-D modeling
MEDUSA	2-D drafting and solid modeling for VAX- and MicroVAX-based systems
Personal Architect	PC-based 3-D AEC design and drafting system with facilities management module available
Personal Designer	PC-based 3-D mechanical drafting system; optional shading and finite element modeling packages, with interface to PC-based finite element analysis
Personal Engineer	PC-based EDA system; schematic capture and analog (SPICE) and logic and fault (HILO) simulation
Personal	PC-based 2.5-axis numerical control package Machinist
PDM II (Product Data Management)	Data base management software; runs on IBM 43XX hosts for access by CADDS 4X users

Source: Computervision
Dataquest
October 1986



Control Data Corporation

Control Data Corporation
8100 34th Avenue South
Minneapolis, Minnesota 55420
Telephone: (612) 853-8100
(Millions of Dollars Except per Share Data)

Corporate Financial Profile as of December 31

Balance Sheet

	1981	1982	1983	1984	1985	CAGR 1981-1985
Working Capital	$ 549.1	$ 534.8	$ 602.0	$ 464.1	($ 121.2)	N/M
Long-Term Debt	$ 116.8	$ 188.9	$ 167.1	$ 322.6	$ 96.2	(4.7%)
Shareholders' Equity	$1,577.6	$1,725.0	$1,825.5	$1,758.8	$1,202.6	(6.6%)
After-Tax Return on Average Equity (%)	11.3%	9.4%	9.1%	0.3%	(38.3%)	
Operating Performance						
Revenue	$4,126.7	$4,340.3	$4,582.8	$3,692.6	$3,679.7	(2.8%)
U.S. Revenue	$3,084.4	$3,229.9	$3,465.5	$2,675.2	$2,620.6	(4.0%)
Non-U.S. Revenue	$1,042.3	$1,110.4	$1,117.3	$1,017.4	$1,059.1	0.4%
Cost of Goods Sold	$1,925.7	$2,040.2	$2,181.5	$2,326.7	$2,582.1	7.6%
Gross Margin	$2,201.0	$2,300.1	$2,401.3	$1,329.9	$1.097.6	(16.0%)
Expenses	$1,832.3	$1,977.0	$2,111.9	$1,315.2	$1,505.7	(4.8%)
R&D Expense	$ 293.8	$ 325.9	$ 379.7	$ 416.9	$ 438.3	10.5%
SG&A Expense	$ 626.9	$ 693.0	$ 711.9	$ 724.8	$ 752.8	4.7%
Other Expense	$ 911.6	$ 958.1	$1,020.3	$ 155.5	$ 314.6	(23.4%)
Operating Income	$ 368.7	$ 323.1	$ 289.4	$ 14.7	($ 408.1)	N/M
Interest Expense	($ 77.9)	($ 100.4)	($ 81.9)	($ 90.0)	($ 115.7)	10.4%
Interest Income						N/M
Other Income				$ 49.6		N/M
Income before Tax	$ 290.8	$ 222.7	$ 207.5	($ 25.7)	($ 523.8)	N/M
Note: Pretax Margin	7.0%	5.1%	4.5%	(0.7%)	(14.2%)	
Taxes	$ 120.2	$ 67.6	$ 45.8	($ 30.8)	$ 43.7	(22.3%)
Note: Effective Tax Rate	41.3%	30.4%	22.1%	N/M	(8.3%)	
Net Income after Tax	$ 170.6	$ 155.1	$ 161.7	$ 5.1	($ 567.5)	N/M
Shareholder Data						
Average Shares Outstanding (Millions)	37.7	37.6	38.3	38.5	39.9	1.4%
Per Share Data						
Earnings	$ 4.48	$ 4.11	$ 4.20	$ 0.12	($ 14.56)	N/M
Dividends	$ 0.52	$ 0.57	$ 0.60	$ 0.66	$ 0.54	0.9%
Book Value	$ 41.80	$ 45.88	$ 47.66	$ 45.66	$ 30.12	(7.9%)
Price Range (Low)	$ 30 3/8-	$ 21 1/8-	$ 35 1/2-	$ 24 3/8-	$ 15 1/8-	
(High)	42 1/8	37 3/4	63 1/4	48 1/2	38 3/4	
Total Employees	60,627	56,005	55,858	54,123	44,308	(7.5%)
Revenue per Employee	$ 68,067	$ 77,498	$ 82,055	$ 68,226	$ 83,048	5.1%

N/M = Not Meaningful

Source: Control Data Corporation
Dataquest
March 1987

Control Data Corporation
8100 34th Avenue South
Minneapolis, Minnesota 55420
Telephone: (612) 853-8100

Line Items as a Percent of Total Revenue

	1981	1982	1983	1984	1985
Operating Performance					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
U.S. Revenue	74.7%	74.4%	75.6%	72.4%	71.2%
Non-U.S. Revenue	25.3%	25.6%	24.4%	27.6%	28.8%
Cost of Goods Sold	46.7%	47.0%	47.6%	64.0%	70.2%
Gross Margin	53.3%	53.0%	52.4%	36.0%	29.8%
Expenses	44.4%	45.5%	46.1%	35.6%	40.9%
R&D Expense	7.1%	7.5%	8.3%	11.3%	11.9%
SG&A Expense	15.2%	16.0%	15.5%	20.1%	20.5%
Other Expense	22.1%	22.1%	22.3%	4.2%	8.4%
Operating Income	8.9%	7.4%	6.3%	0.4%	(11.1%)
Interest Expense	(1.9%)	(2.3%)	(1.8%)	(2.4%)	(3.1%)
Interest Income	0	0	0	0	0
Other Income (Expense)	0	0	0	1.3%	0
Income before Tax	7.0%	5.1%	4.5%	(0.7%)	(14.2%)
Taxes	2.9%	1.6%	1.0%	(0.8%)	1.2%
Net Income after Tax	4.1%	3.6%	3.5%	0.1%	(15.4%)

Source: Control Data Corporation
Dataquest
March 1987

THE COMPANY

Founded

Control Data Corporation (CDC) was founded in 1957 in Minnesota. In 1983, CDC created the Computer Integrated Manufacturing Division, which encompasses the Company's mechanical CAD, PCB CAD, and manufacturing automation products. The CIM Division's primary product is ICEM. The Government Systems group sells electronic CAD products to both commercial and government users, emphasizing military applications. This group's primary product is known as MIDAS.

Positioning

CDC sells and supports turnkey systems, and personal computer-based systems and software for mechanical, AEC, EDA, IC, and PCB CAD applications. In addition, the Company offers most of its CAD software through time-sharing. CDC derives 3 percent of its revenue from CAD markets. The Company's performance and market share history is shown in Tables 1 and 2.

The Company manufactures and markets a range of medium to large scale general-purpose computer systems called the CYBER series. These systems are used primarily in engineering, educational, and scientific environments. CYBER systems are sold, leased, or offered through CDC's Scientific Information Service (SIS), a time-share network. SIS was formerly known as CYBERNET.

Table 1

Control Data Corporation
CAD/CAM Performance
(Millions of Dollars/Actual Units)

	1993	1984	1985
Revenue	$ 34	$ 50	$ 116
Workstations Shipped	489	436	856
Workstations Installed	491	904	1,755

Source: Dataquest
March 1987

Table 2

Control Data Corporation
CAD/CAM Market Share History
(Percent Market Share by Segment)

	1983	1984	1985	1985 Rank in Market
All Applications				
Revenue	2%	1%	2%	10
Workstations Shipped	3%	1%	1%	12
Mechanical				
Revenue	3%	2%	3%	7
Workstations Shipped	5%	1%	1%	9
AEC				
Revenue	0	0	1%	12
Workstations Shipped	0	0	1%	12
EDA				
Revenue	1%	3%	3%	6
Workstations Shipped	1%	1%	1%	6
IC				
Revenue	2%	1%	2%	7
Workstations Shipped	6%	2%	2%	8

Source: Dataquest
March 1987

FINANCIAL

Revenue

CDC's 1986 worldwide revenue was $3,346.7 million; 1986 net loss to the Company was $264.5 million. Detailed financial information for 1986 is not available at this writing.

CDC as a whole suffered a severe financial struggle during the last two years. The Company has undergone extensive consolidation and reorganization of its operations, particularly in the data storage and financial groups.

Although CDC does not provide detailed financial data by segments, the Company does state that revenue from the Company's Scientific/Engineering Systems and Services product group increased approximately 6 percent in the last two years. This product group includes CDC's CAD/CAM product line.

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- November 1986—The Company announced its first UNIX-based technical workstation, the Cyber 910-300. The system is currently available with either PATRAN or ICEM Design/Drafting software. The workstation is a Silicon Graphics 3000, with a drawing speed of 130,000 vectors per second. The workstations can be networked to the CYBER 180 Series 800 host computers.

- July 1986—CDC announced the PC4107 Emulator, which allows a personal computer to emulate a CDC host-dependent workstation for access to host-based ICEM software.

- June 1986—CDC Government Systems announced an agreement with Gateway Design Automation Corporation to convert four digital logic design programs to run on CDC Cyber 180 series computers. Gateway's products include a mixed-level simulator, a logic and concurrent fault simulator, and an automatic test pattern generation program.

- June 1986—CDC Government Systems announced an agreement with Endot, Inc., to convert Endot's N.2 to run on CDC Cyber 180 computers. N.2 provides hierarchical specification, design, and functional and performance simulation of complex digital systems including VLSI chips, PC boards, and systems.

- June 1986—CDC Government Systems announced an agreement with Rockwell International to develop and market high-density silicon-on-sapphire ICs. Under the terms of the agreement, a new gate array family will be marketed by Rockwell that includes built-in, self-test facilities based upon proprietary Control Data technology.

- March 1986—CDC CIM announced a comprehensive CAD/CAM system for plastics and plastics molds. The complete system is composed of 21 applications programs developed by CDC and 12 third-party vendors.

- 1986—The Company's CIM Division announced that it will begin offering PCB layout software from an undisclosed source for the PC-based Electronics Designer.

ORGANIZATION

Personnel

Control Data employed approximately 36,000 people in its computer business on September 30, 1986.

Operations

CDC is engaged in three core businesses: scientific/engineering systems and services, data storage products, and financial information and commercial services.

The Computer Integrated Manufacturing (CIM) Division is part of the Scientific/Engineering product group. This division is located at company headquarters in Minneapolis, Minnesota. The Government Systems group offers gate array design systems and time-sharing through a design center in Plymouth, Michigan, to military, commercial, and internal users.

MARKETING AND SALES

Strategy

CDC's CIM Division entered the CAD market through sales of structural analysis systems to the Company's substantial base of computers installed at manufacturing sites. The Company should be able to continue to capitalize on sales to a captive audience of CDC computer users.

The CIM Division has also assembled a comprehensive plastics package, which includes analysis, mold machining, and consulting services. As plastics steadily grow as a percent of mechanical product content, CDC will be in a strong position to exploit experience in the CAD plastics design market niche.

CDC's Government Systems group offers gate array design to military, commercial, and internal users; a high percentage of this group's revenue comes from its Michigan design center. The Government Systems group has embarked on the relatively uncharted course of selling internally-developed software and integration capabilities to outside users. This group intends to offer additional software sourced from both third parties and from internal development.

Distribution

CDC sells its CAD products directly through 50 U.S. sales offices and also through all non-U.S. sales offices.

In addition, the Company markets its current high-end computer, the CYBER 205 through ETA systems, an 89 percent owned subsidiary.

SALES SUPPORT

The Company emphasizes services: time-sharing, consulting, training, and product support. CDC averages 42 percent of revenue from services, and the Company indicates that CAD-related operations maintain a comparable percent of service revenue. This service background could serve CDC well in the future: Dataquest believes that services are a major emerging revenue opportunity for CAD vendors.

Training and Application Support

Training is offered at CDC's training centers in Minneapolis, Minnesota, and Frankfurt, Germany; training can also be scheduled at customer sites and at Company sales offices. College credit can be obtained for CDC CAD training.

CDC has design centers in Sunnyvale, California, and Arden Hills, Minnesota. At these centers, users can rent time on a CAD terminal for design applications and also receive training and consulting help on ICEM systems. The Company also operates manufacturing, petroleum, and mining applications centers in Waltham, Massachusetts; Houston, Texas; and Tucson, Arizona, respectively. In addition, the Company maintains a gate-array design center with time-sharing services in Plymouth, Michigan.

Maintenance

CDC offers monthly maintenance on host computers ranging from $500 per month for the Cyber 180 Series 810 to $14,000 for the high-end Cyber 180 Series 995E.

STRATEGIC ALLIANCES

Joint Developments

The ICEM Configuration Manager, a product data manager, was developed jointly by CDC and Northrop Corporation. CDC and Volkswagon are jointly developing mechanical-surfacing software.

OEM Agreements

CDC sells group-technology software from the Organization for Industrial Research; and PATRAN mechanical-analysis software from PDA Engineering.

In addition, portions of the Company's plastics offering are supplied by the following third-party vendors:

- ABAQUS from Hibbit, Karlsson and Sorenson, Inc.
- ANSYS from Swanson Analysis Systems, Inc.
- CADMOULD from Institute for Plastics Processing
- CUTDATA from Metcut Research Associates, Inc.
- DUCT from Deltacam
- HASCO from Hasco-Normalien
- MOLDCOOL II and MOLDFILL from Application Engineering Corporation
- MOLDFLOW from Moldflow Australia, Pty., Ltd.
- MOLDSTAR from Cadsultants
- NASTRAN from National Aeronautics and Space Administration
- PATRAN from PDA Engineering
- PLASPEC from Bill Publications

Joint Marketing Agreements

CDC's Independent Software Vendor program assists third-party software vendors in converting their products to the CYBER 180 product line and in marketing them directly or through Control Data's sales force.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- November 1985—The Company announced the ICEM Configuration Manager, which provides product and part data. The software was developed jointly with Northrop Corporation.
- April 1985—CDC announced the ICEM 793 Intelligent Workstation, a dual-display technical workstation for mechanical applications.
- March 1985—The Company announced Electronics Designer, a PC-based CAD system for PCB applications.
- 1983—The CDC created the Computer Integrated Manufacturing Division, which encompasses the company's CAD/CAM and manufacturing automation products.
- 1982—CDC announced ICEM, the Company's core CAD software.
- 1980—The Company's first CAD system was installed.

CAD/CAM PRODUCTS

Market Segment Participation

CDC sells and supports turnkey host-dependent systems and technical workstations as well as personal computer-based systems and software for mechanical, AEC, EDA, IC, and PCB CAD applications.

Products

The Company's products are summarized in Table 3. The pages following this table provide a detailed description of each product, with one product per page. These product pages are presented in the order in which they appear in Table 3.

The CIM division's primary product is ICEM. The Government Systems group's primary product is MIDAS. CDC offers both ICEM and MIDAS products on a time-sharing service called SIS. The service is offered seven days a week, and is priced either on a per-hour basis or as a monthly subscription.

Table 3

Control Data Corporation Products

PERSONAL COMPUTER-BASED WORKSTATIONS

Model	Manufacturer	Resolution	Description
Electronic Designer	IBM	N/A	System includes EDA and PCB lay-out capabilities.

TECHNICAL WORKSTATIONS

Model	Manufacturer	Resolution	Description
ICEM 793 Intelligent Workstation	Control Data	1,280 x 1,024	Dual screen system. Two configurations: Either Design/Drafting/NC or PATRAN (FEM/FEA) AOS/VS operating system
CYBER, 910-300	Silicon Graphics	1,024 x 768	Currently runs PATRAN software or ICEM Design/Drafting software. Can be networked to CYBER 180 Series 800 computers. Based on Silicon Graphics 3000; uses 12 parallel graphics processors. Drawing speed is 130,000 vectors/second. UNIX V operating system

HOST SYSTEMS

Model	Manufacturer	Number of Users	Description
ICEM 794 Workstation Cluster	Control Data	2	Can be networked to other CDC CYBER computers. IWOS operating system
ICEM/120	Control Data	6	Can be networked to other CDC Systems. IOS operating system
CYBER 180	Control Data	40	Approximately 15 series offered, from Series 810 through Series 990; all series are used with CAD software. NOS/VE operating system; runs both MIDAS and ICEM software.

HOST-DEPENDENT WORKSTATIONS

Model	Resolution	Displayable Colors	Description
ICEM 790-20 Ergonomic Workstation	1,280 x 1,024	16	Manufactured by Control Data. For CDC host computer
ICEM PC 4107 Emulator	800 x 600	16	CDC terminal emulation for PC XT and AT for access to ICEM software

(Continued)

Table 3 (Continued)

Control Data Corporation Products

APPLICATION SOFTWARE

Model	Platform	Segment	Description
Electronic Designer	PC	EDA	Includes SALT logic simulation and timing analysis. Options: Verilog behavioral simulation, MicroASPEC analog simulation, Micro-OPTIMOS model parameter extraction, and OCEANVIEW waveform analysis Functions: schematic capture, logic simulation, circuit simulation, behavioral simulation Runs on PC XT or AT
Electronic Designer, ED Layout	PC	PCB	Manual and automatic PCB layout
ICEM, Information Management	Host-dependent	Data base management	Modules include data base management with engineering data and parts geometry library, and Configuration Manager, which provides project/product data.
ICEM, Design/Drafting workstation	Technical	Mechanical	Functions include two-dimensional and three-dimensional drafting. Runs on Cyber 910-300 technical workstation
ICEM, Design/Drafting/NC	Host-dependent	Mechanical	Functions include two-dimensional, three-dimensional, drafting, numerical control, design/analysis, and FEM/FEA. Requires ICEM information-management software
ICEM, Specialized Applications	Host-dependent	Mechanical	Modules include solid modeling, facilities management, hydraulics, kinematics, group technology, plastics, and third-party analysis software, including ABAQUS, ANSYS, NASTRAN, GT STRUDL, and PATRAN. Runs on ICEM Design/Drafting
MIDAS, Base Package	Host-dependent	IC	Offered as design service, on time-sharing, or on Cyber 180 Series 810 through 990 Modules include logic language, layout, simulation, and DRC/ERC. Functions include IC gate array, logic simulation, circuit simulation, fault simulation, behavioral simulation, and testing.

Source: Data Control Corporation
Dataquest
March 1987

PRODUCT DESCRIPTION

Price: $86000

Model: ICEM 794 Workstation Cluster
Type: Host Computer System

System Configuration:

Manufacturer: Control Data
Operating System: IWOS

2.0 Mbyte main memory included. Expandable to 4 Mbyte
120 Mbyte disk memory included.
2 users maximum

CAD Application Software:
three-dimensional (mech.), mechanical drafting, mechanical design/analysis
numerical control

Prerequisites:
Either CDC 790-20 or Tektronix 4109 host-dependent workstations

Comments:
Can be networked to other CDC CYBER computers. Price range: $86K to $128K.

8702-0411-1949 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: ICEM/120
Type: Host Computer System

System Configuration:

Manufacturer: Control Data
Operating System: IOS
Communication Protocols: Ethernet, X.25

Word size: 32
4.0 Mbyte main memory included.
147 Mbyte disk memory included. Expandable to 2408 Mbyte
6 users maximum

CAD Application Software:
three-dimensional (mech.), mechanical drafting, mechanical design/analysis
numerical control, FEM/FEA

Prerequisites:
CEC 790-20 or Tektronix 4107 host dependent workstation

Comments:
Can be networked to other CDC Systems. Typical configuration.

8702-0411-2318 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: Cyber 180
Type: Host Computer System

System Configuration:

Manufacturer: Control Data
Operating System: NOS/VE
Communication Protocols: CDCNET, LCN

Prerequisites:
ICEM or MIDAS software

Comments:
Approximately 15 series offered, from Series 810 through Series 990; all series are used with CAD software.

8702-1116-2045 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $760000

Model: Cyber 180 Series 800
Type: Host Computer System

System Configuration:

Manufacturer: Control Data
Operating System: NOS/VE
Communication Protocols: CDCNET, LCN

Word size: 64
16.0 Mbyte main memory included. Expandable to 128 Mbyte

4 workstations included. 40 users maximum

Comments:
Models are 840 ($760K), 850 ($1.12M) and 860 ($1.58M)

8702-0411-4443 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $32500

Model: ICEM 790-20 Ergonomic Wkstn.
Type: Host-Dependent Workstation

Workstation Configuration:

Manufacturer: Control Data
1280 x 1024 resolution. 16 displayable colors
Upgrade description: 256 colors

Prerequisites:
CDC host computer

Comments:
Dual alphanumeric and graphic display. Includes tablet.

8702-0608-1314 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $6000

Model: ICEM PC 4107 Emulator
Type: Host-Dependent Workstation

Workstation Configuration:

800 x 600 resolution. 16 displayable colors
Upgrade description: To 19" screen

Comments:
CDC terminal emulation for PC XT and AT for access to ICEM software on CDC CYBER line. Includes PC graphics controller card, color graphics monitor. Price range: $6K to $6.6K.

8702-0411-2118 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $300000

Model: ICEM, Information Management
Type: Data Base Management Software
Hardware Platform: Host-Dependent

CAD Application Software:
production planning

Prerequisites:
CDC CYBER 180 or ICEM 120 host computers.

Comments:
Modules include data base management system with engineering data and parts geometry library, and Configuration Manager, which provides project/ product data for accounting, material resources planning, inventory control. Price is 1 time charge for Configuration Manager on Cyber 180.

8702-0410-5912 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $4500

Model: Electronic Designer, ED Layout
Type: CAD Application Software for PCB Applications
Hardware Platform: PC

System Configuration:

Communication Protocols: SIS

CAD Application Software:
PCB layout

Prerequisites:
PC AT or XT with color monitor

Comments:
Price is for manual layout. Auto layout (ED Router): $4000.

8702-1211-1214 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $14500

Model: Electronic Designer
Type: CAD Application Software for EDA Applications
Hardware Platform: PC
Date of product introduction: 1985

CAD Application Software:
schematic capture, logic simulation, circuit simulation
behavioral simulation

Prerequisites:
PC XT or AT

Comments:
Includes SALT logic simulation and timing analysis @ $3500; schematic capture @ $6000, Verilog behavioral simulation @ $5000. Options: MicroASPEC analog simulation @ $1100; MicroOPTIMOS MOS modeler @ $1000; OCEANVIEW waveform analysis @ $1000.

8702-0608-1552 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: ICEM, Design/Drafting
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation

System Configuration:

Operating System: UNIX V

CAD Application Software:
two-dimensional (mech.), three-dimensional (mech.), mechanical drafting

Prerequisites:
Cyber 910-300 technical workstation

8702-0410-5707 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $1500

Model: ICEM, Design/Drafting/NC
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent

System Configuration:

Operating System: NOS

CAD Application Software:
two-dimensional (mech.), three-dimensional (mech.), mechanical drafting numerical control, mechanical design/analysis, FEM/FEA

Prerequisites:
CDC Cyber with ICEM information management software

Comments:
One-time fee ranges from $38.5K to $102.2K

8702-0410-5336 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: ICEM, Engineering Analysis
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent

CAD Application Software:
mechanical design/analysis, FEM/FEA, image processing

Prerequisites:
ICEM information management software

Comments:
Third-party programs include ABAQUS stress analysis, ANSYS, NASTRAN, GTSTRUDL, and PATRAN.

8702-0411-0348 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: ICEM, Facilities
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent

CAD Application Software:
facilities management

Prerequisites:
ICEM Design/Drafting

0702-0514-2923 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: ICEM, Hydraulics
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent

CAD Application Software:
mechanical design/analysis

Prerequisites:
ICEM Design/Drafting

Comments:
Specialized programs for design of hydraulic systems

8702-0514-2631 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: ICEM, Kinematics
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent

CAD Application Software:
mechanisms/kinematics

Prerequisites:
ICEM Design/Drafting

8702-0514-2842 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: ICEM, MultiClass
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent

CAD Application Software:
group technology

Prerequisites:
ICEM Information Management package

Comments:
Options: MultiClass, MultiCapp and MultiGroup group technology software from Organization for Industrial Research

8702-0606-1203 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $4000

Model: ICEM, Plastics
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent

CAD Application Software:
solids, other manufacturing, three-dimensional (mech.)
mechanical drafting, mechanical design/analysis, FEM/FEA
numerical control

Prerequisites:
CYBER 180 host computer

Comments:
Complete package is composed of 21 software programs developed by CDC and 12 software vendors. $4K for single application software; $150,000 for 1-user system; $200,000 for 2-user system; on CYBER 180, 6-user system for $600,000--with additional workstations at $10,000 to $32,500.

8702-0411-1151 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Model: ICEM, Solid modeler
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent

CAD Application Software:
solids

8702-0410-5823 CONTROL DATA CORP.

PRODUCT DESCRIPTION

Price: $20000

Model: Midas, Base Package
Type: CAD Application Software for IC Applications
Hardware Platform: Host-Dependent

CAD Application Software:
IC gate array, logic simulation, circuit simulation
fault simulation, behavioral simulation, testing

Prerequisites:
Cyber 180 host computer

Comments:
Price ranges are on Cyber 180 Series 810 through 990. Base Package (includes DBMS, logic language, layout): $20K to $135K. Simulation and DRC/ERC: (BEV, Path Trace, Assist, Zycad's LE and FE): $50K to $240K. Test package: $20K to $75K.

8702-1116-3154 CONTROL DATA CORP.

Control Data Corporation

Control Data Corporation
8100 34th Avenue South
Minneapolis, Minnesota 55420
Telephone: (612) 853-8100
(Millions of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF APRIL 1

	1979	1980	1981	1982	1983	CAGR 1979-83
BALANCE SHEET						
Working Capital	$ 402.1	$ 485.4	$ 549[redacted]	$ 534.8	$ 602.0	10.6%
Long-Term Debt	$ 161.1	$ 122.9	$ 11[redacted]	$ 188.9	$ 167.1	0.9%
Shareholders' Equity	$1,177.2	$1,437.0	$1,577.6	$1,725.0	$1,825.5	11.6%
After-Tax Return on Average Equity	10.6%	11.3%	9.3%	9.4%	9.1%	N/M
OPERATING PERFORMANCE						
Revenue	$3,212.0	$3,783.6	$4,126.7	$4,340.3	$4,582.8	9.3%
U.S. Revenue	$1,836.1	$2,206.2	$3,084.4	$3,229.9	$3,465.5	17.2%
Non-U.S. Revenue	$1,375.9	$1,577.4	$1,042.3	$1,110.4	$1,117.3	(5.1%)
Expenses	$2,118.2	$2,5[illegible]2.8	$2,846.4	$3,059.1	$3,273.1	11.5%
Cost of Revenue	$1,518.6	$1,873.2	$1,925.7	$2,040.2	$2,181.5	9.5%
R&D Expense	$ 149.3	$ 182.8	$ 201.9	$ 220.5	$ 270.7	16.0%
SG&A Expense	$ 450.3	$ 536.8	$ 626.9	$ 693.0	$ 711.9	12.1%
Operating Income	$1,093.8	$1,190.8	$1,280.3	$1,281.2	$1,309.7	4.6%
Income before Tax	$ 130.4	$ 172.8	$ 208.9	$ 229.3	$ 213.6	13.1%
NOTE: Pretax Margin	4.1%	4.6%	5.1%	5.3%	4.7%	N/M
Taxes	$ [redacted]3.0	$ 112.4	$ 120.2	$ 67.6	$ 45.8	(20.2%)
NOTE: Effective Tax Rate	47.1%	46.0%	40.3%	47.7%	30.0%	N/M
Net Income after Tax	$ 118.5	$ 147.8	$ 140.6	$ 155.1	$ 161.7	8.1%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	35.0	35.3	37.7	37.6	38.3	N/M
Per Share						
Earnings	$ 3.43	$ 4.15	$ 4.48	$ 4.11	$ 4.20	5.2%
Dividend	$ 0.20	$ 0.30	$ 0.52	$ 0.57	$ 0.60	31.6%
Book Value	$ 34.53	$ 37.94	$ 41.80	$ 45.90	$ 47.60	8.4%
Price Range (Low)	$ 14 1/2-	$ 21 1/2-	$ 30 3/8-	$ 21 1/8-	$ 35 1/2-	N/M
(High)	28 1/2	38 3/4	42 1/8	37 3/4	63 1/4	N/M
TOTAL EMPLOYEES	57,182	57,068	60,627	56,005	55,858	(0.6%)

N/M = Not Meaningful

Source: Control Data Corporation
1983 Annual Report & Forms 10K
DATAQUEST

Control Data Corporation

Control Data Corporation
8100 34th Avenue South
Minneapolis, Minnesota 55420
Telephone: (612) 853-8100

LINE ITEMS AS A PERCENT OF TOTAL REVENUE

	1979	1980	1981	1982	1983
Operating Performance					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
U.S. Revenue	57.2%	58.3%	74.7%	74.4%	75.6%
Non-U.S. Revenue	42.8%	41.7%	25.3%	25.6%	24.4%
Expenses	65.9%	68.5%	69.0%	70.5%	71.4%
Cost of Revenue	47.3%	49.5%	47.7%	47.0%	47.6%
R&D Expense	4.6%	4.8%	7.1%	7.5%	8.3%
SG&A Expense	14.0%	14.2%	15.2%	16.0%	15.5%
Operating Income	34.1%	31.5%	31.0%	29.5%	28.6%
Income before Tax	4.1%	4.6%	5.1%	5.3%	4.7%
Taxes	3.5%	3.0%	2.9%	1.6%	1.0%
Net Income after Tax	3.7%	3.9%	3.4%	3.6%	3.5%
Revenue Per Employee (Millions of Dollars)	$ 0.1	$ 0.1	$ 0.1	$ 0.1	$ 0.1

Source: DATAQUEST

Control Data Corporation

THE COMPANY

Background

Control Data Corporation (CDC) was organized in 1957 in Minnesota. In 1968 CDC merged with the Commercial Credit Company and became a Delaware corporation.

Highlights - CAD/CAM Business

In late 1983, CDC created the Computer Integrated Manufacturing Division, which pulled together all CDC activities related to CAD/CAM and manufacturing. Since the formation of this division, CDC has been aggressively expanding its CAD/CAM operations.

At the Design Automation Conference in June 1984, CDC introduced MIDAS (Modular Integrated Design Automation System). MIDAS is an integrated set of software modules for electronic design applications. CDC also announced a schematic entry package running on the IBM personal computer.

With its introduction of the MIDAS system, CDC has applications packages that address the largest segments of the CAD/CAM market--mechanical and electronic. DATAQUEST estimates that CDC's turnkey CAD/CAM revenue for 1983 was $33 million. CDC also generates a good portion of its CAD/CAM revenue from time-share services and design centers. DATAQUEST believes that CDC's unique marketing strategy--offering both turnkey solutions and time-share/design center services--allows CDC to remain close to its end users and aware of their needs. Through this strategy, CDC is in a position to develop state-of-the-art CAD/CAM solutions based directly on its customers' requirements.

Operations

CDC's operations are reported in two business segments: Information Services and Products and Financial Services. CDC's 1983 revenue percentages by business segment were 77 percent for Information Services and Products and 23 percent for Financial Services.

CDC designs, develops, manufactures, and markets a range of medium-to-superscale general-purpose computer systems called the CYBER series. These systems are used primarily in engineering, educational, and scientific environments. CYBER systems are sold, leased, or offered by CDC through CYBERNET, a time-share network.

CDC also designs, manufactures, and markets a broad line of computer peripherals equipment for use with CDC computers as well as systems of other computer companies.

Information Services and Products' computer-related services include scientific and engineering applications, business data processing, engineering, education, consulting, health care, and small business services. Scientific and engineering data processing applications include construction, manufacturing, electronics, and energy management and, to an increasing extent, computer-aided-design and computer-aided-manufacturing (CAD/CAM).

CDC's Financial Services conducts business through its wholly owned subsidiary, Commercial Credit Company. Financial services include financing and leasing, casualty insurance, business credit insurance, and life insurance.

Information Services and Products employed 49,279 persons and Financial Services employed 6,579 persons as of December 31, 1983.

Research and Development

Research and development work, primarily company-sponsored or sponsored in part by the company with other participants through a variety of cooperative arrangements, is being conducted on computer network technology, computer systems, peripherals equipment, and operating system and applications software. R&D expenses were $270.7 million or approximately 6 percent of total Company revenue in 1983.

CAD/CAM Business

Through its Computer Integrated Manufacturing Division, CDC offers two integrated families of CAD/CAM products for the mechanical and electronics segments of the CAD/CAM industry.

ICEM (Integrated Computer-Aided Engineering and Manufacturing)

ICEM is a group of software modules that integrate the manufacturing process from the design and analysis stages through numerically controlled production.

At the core of the ICEM solution set is the Engineering Data Library (EDL) that allows massive amounts of parts geometry and other engineering and manufacturing data to be contained in a single data base.

The ICEM family consists of three standalone turnkey systems:

- ICEM/120-40--A 16-bit desktop workstation
- ICEM/120-70--Based on Data General's 32-bit MC4000 computer; can support up to four workstations
- ICEM/800--Based on the 60-bit CYBER 170 series; can support from 10 to 40 workstations

Available ICEM applications software includes: geometric modeling, design/drafting, finite element modeling and analysis, numerical control, facilities planning, PCB routers/schematics, and hydraulics.

MIDAS (Modular Integrated Design Automation Systems)

MIDAS, an integrated set of applications software for electronic design, includes modules for logic simulation, fault simulation, and layout. MIDAS features an integrated data base and an engineering data library, similar to ICEM's EDL.

MIDAS operates on CDC's CYBER computer series and the CYBERNET data services network.

Applications/Design Centers

CDC has electronic design centers in Sunnyvale, California, and Arden Hills, Minnesota. At these centers, users can rent time on a CAD terminal for design applications and receive training and consulting help on the ICEM and MIDAS systems. CDC also operates manufacturing, petroleum, and mining applications centers in Waltham, Massachusetts; Houston, Texas; and Tucson, Arizona, respectively.

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Daisy System Corporation

Daisy System Corporation
700 Middlefield Road
Mountain View, California 94039-7006
Telephone: (415) 960-0123 Telex: 858262
(Millions of Dollars)

CORPORATE FINANCIAL PROFILE AS OF SEPTEMBER 30

	1981	1982	1983	1984	CAGR 1981-84
BALANCE SHEET DATA					
Working Capital	$ 1.1	$ 7.7	$ 37.1	$ 39.4	229.9%
Long-Term Debt	$ 0.2	$ 0.6	$ 0.5	$ 0.0	(100.0%)
Shareholders' Equity	$ 1.2	$ 8.1	$ 39.2	$ 51.0	251.3%
After-Tax Return on Average Equity	N/A	231.0%	56.2%	33.5%	
OPERATING PERFORMANCE					
Revenue	$ 0.0	$ 4.6	$ 17.5	$ 69.1	N/M
U.S. Revenue	$ 0.0	$ 3.8	$ 13.2	$ 47.7	N/M
Non-U.S. Revenue	$ 0.0	$ 0.7	$ 4.3	$ 21.4	N/M
Cost of Goods Sold	$ 0.0	$ 1.2	$ 4.1	$ 17.3	N/M
Gross Margin	$ 0.0	$ 3.3	$ 13.4	$ 51.8	N/M
Expenses	$ 0.7	$ 3.2	$ 11.3	$ 35.2	276.3%
R&D Expense	$ 0.7	$ 1.6	$ 4.1	$ 11.2	156.9%
SG&A Expense	$ 0.0	$ 1.6	$ 7.2	$ 24.0	N/M
Operating Income	($ 0.7)	$ 0.1	$ 2.1	$ 16.6	N/M
Interest Expense	$ 0.0	($ 0.1)	($ 0.1)	($ 0.0)	N/M
Interest Income	$ 0.0	$ 0.2	$ 1.4	$ 2.8	N/M
Income before Tax	($ 0.7)	$ 0.2	$ 3.3	$ 19.4	N/M
NOTE: Pretax Margin	N/M	5.3%	19.0%	28.0%	
Taxes		$ 0.1	$ 1.0	$ 8.4	N/M
NOTE: Effective Tax Rate	0.0%	48.5%	30.0%	43.1%	
Extraordinary Item	$ 0.0	$ 0.1	$ 0.3	$ 0.0	
Net Income after Tax	($ 0.7)	$ 0.2	$ 2.6	$ 11.0	N/M
SHAREHOLDER DATA					
Average Shares Outstanding (Millions)	2.7	10.7	13.3	15.1	77.3%
Per Share Data					
Earnings	($0.29)	$ 0.01	$ 0.17	$ 0.73	N/M
Dividends	$0.00	$ 0.00	$ 0.00	$ 0.00	N/M
Book Value	$0.43	$ 0.76	$ 2.95	$ 3.38	98.2%
Price Range (Low)	N/A	N/A	$14.00	$ 14.00	
(High)	N/A	N/A	$27.00	$27 3/4	
TOTAL EMPLOYEES	N/A	86	232	565	N/M
Revenue Per Employee	N/A	$ 0.1	$ 0.1	$ 0.1	N/M

N/M = Not Meaningful
N/A = Not Available

Source: Daisy System Corporation
Annual Reports & Forms 10-K

Daisy System Corporation

Daisy System Corporation
700 Middlefield Road
Mountain View, California 94039-7006
Telephone: (415) 960-0123 Telex: 858262
(Millions of Dollars)

LINE ITEMS AS A PERCENT OF REVENUE

	1981	1982	1983	1984
OPERATING PERFORMANCE				
Revenue	N/M	100.0%	100.0%	100.0%
United States	N/M	83.7%	75.5%	69.0%
Non-United States	N/M	16.3%	24.5%	31.0%
Cost of Goods Sold	N/M	27.0%	23.3%	25.1%
Gross Margin	N/M	73.0%	76.7%	74.9%
Expenses	N/M	71.2%	64.7%	50.9%
R&D Expense	N/M	35.1%	23.4%	16.2%
SG&A Expense	N/M	36.1%	41.3%	34.7%
Operating Income	N/M	1.9%	12.1%	24.0%
Interest Expense	N/M	(1.3%)	(0.8%)	0.0%
Interest Income	N/M	4.7%	7.7%	4.1%
Income before Tax	N/M	5.3%	19.0%	28.0%
Taxes	N/M	2.6%	5.7%	12.1%
Net Income after Tax	N/M	5.0%	14.8%	16.0%

N/M = Not Meaningful

Source: Daisy System Corporation
Annual Reports & Forms 10-K

Daisy System Corporation

BACKGROUND

The Company

Daisy Systems Corporation was founded in August 1980 in Sunnyvale, California. The Company designs, manufactures, and sells electronic CAD/CAM systems. Daisy was the first company to deliver EDA products for the IC design engineer on a standalone workstation-based product.

Highlights

- December 1984--Daisy announced the acquisition of Vulcan Software, a company based in Campbell, California, that develops mechanical design and drafting tools.

- December 1984--The Company announced a printed circuit board CAD package developed by its R&D group in Israel.

- November 1984--The Company made a public offering of 1.25 million shares of common stock. The offering was made through an underwriting group managed by L. F. Rothschild, Unterberg, Towbin; F. Eberstadt & Co., Inc.; and Alex Brown & Sons. Proceeds of $29 million were generated from this second public offering.

- November 1984--Daisy Systems and Silicon Compilers, Incorporated (based in Los Gatos, California), announced a joint technology agreement to develop a design methodology incorporating Daisy's EDA tools and Silicon Compilers' compilation technology for VLSI design.

- November 1984--The Company announced the Personal Logician AT. It is the first Daisy system to offer fully integrated design entry and simulation on an IBM Personal Computer-based system.

- June 1984--Daisy introduced the first Personal Logician. Based on the IBM PC XT, the Personal Logician is an entry system that provides logic and schematic entry and data-base support.

- June 1984--Daisy presented the Chipmaster, a full-custom IC CAD system incorporating the Intel 80286 and the AMD 29116 processors.

- March 1984--The Company introduced the Physical Modeling Extension (PMX) to run on the Megalogician. It allows users to run components hardware prototypes concurrently with software simulation.

Organization

In 1984, Daisy relocated its corporate headquarters from Sunnyvale to Mountain View, California. The two-building, 208,000-square-foot complex houses the Company's administration, research and development, marketing, manufacturing, and customer service. Daisy has options to expand the facility to 312,000 square feet over the next ten years.

The Company restructured its research and development, engineering, and product marketing operations. Four operating divisions (Design Engineering, Physical Layout, Systems, and Electromechanical) have been established. The Design Engineering Division and Physical Layout Division are newly created, whereas the Systems Division represents an expansion of the Company's Personal Systems Division.

The Design Engineering Division is responsible for all logic design and verification strategies. Its current product line includes the Logician, Megalogician, and PMX.

The Physical Layout Division has responsibility for all layout strategies, including the Gatemaster and Chipmaster families of products.

The Systems Division will provide the basic hardware and operating system software technology for the Company. It is also responsible for the development and marketing of the Personal Logician product line.

With the acquisition of Vulcan Software, Incorporated, the Company also has an Electromechanical Division.

Daisy Systems employs 675 people in 28 locations throughout the world.

Marketing and Sales

Daisy Systems markets and services its products through a direct sales force in the United States and overseas. In 1984, the Company entered into distributorship agreements with Wyle Laboratories of Irvine, California, for its Personal Logician Workstations. Daisy has eighteen domestic sales offices, which also serve as customer support centers; these are maintained at the following locations:

- Phoenix, Arizona
- La Jolla, California
- Newport Beach, California
- Sunnyvale, California
- Woodland Hills, California
- Denver, Colorado
- Orlando, Florida
- Norcross, Georgia
- Oak Brook, Illinois
- Waltham, Massachusetts
- Columbia, Maryland
- Minnetonka, Minnesota
- Cedar Knolls, New Jersey
- Albuquerque, New Mexico
- Miamisburg, Ohio
- Austin, Texas
- Irving, Texas
- Bellevue, Washington

International Sales

The Company holds several leases on sales facilities in the United Kingdom, West Germany, France, and Israel. International sales made up 31 percent of Daisy's net revenues for fiscal 1984, an increase of 6 percent from fiscal 1983. Daisy's overseas sales offices are located in the following areas:

- Hampshire, England
- Paris, France
- Tel-Aviv, Israel
- Milan, Italy
- Tokyo, Japan
- Stockholm, Sweden
- Taipei, Taiwan
- Karlsruhe, West Germany
- Munich, West Germany

Daisy's overseas offices serve as both sales and customer support centers.

Daisy Systems maintains a one-to-one ratio of salespeople to applications engineers (AEs). The Company's AEs are responsible for both pre- and post-sales support. Daisy's worldwide marketing, sales, and support personnel totaled 279 as of December 1984, up from 228 in September 1984.

Research and Development

The Company focuses its product development in four areas: specialized application software, advanced hardware stations, system software, and application-specific hardware accelerators. Application software is the main emphasis of the Company's research and development efforts. Daisy employs more than 250 people in its R&D division.

Daisy spent $11.2 million, or 16 percent of revenue, on research and development in fiscal 1984, compared to $4.1 million, or 24 percent of revenue, in fiscal 1983. For more information regarding the Company's R&D expenditures, please refer to Table 1.

Manufacturing

Daisy's manufacturing strategy is to integrate standard parts typically available from multiple sources. Manufacturing operations consist of the assembly, test, and quality control of component parts and subassemblies. The Company contracts with several sources for portions of the assembly, including sheet metal fabrication, printed circuit board stuffing, and wave soldering. Daisy performs testing and burn-in of its systems during final product integration.

Cost of goods sold was 25 percent of revenues for fiscal 1984, up from 23 percent in fiscal 1983. The increase in 1984 is due to increased manufacturing costs of new products and large volume discounts.

Support

Upon the sale of a system, a 90-day warranty (from date of installation) is established. After this period, the Company offers two types of annually renewable service contracts to be purchased. The first contract includes service and software updates on the system.

The second type of maintenance agreement is used by a majority of Daisy's customers. In this instance, the customer is responsible for diagnosing problems in the system. In accordance with this contract, Daisy will ship new boards to the customer within 24 hours.

Daisy Systems has training centers at its headquarters in Mountain View, California; in Boston, Massachusetts; and in London, England. The cost of training two operators is included in the purchase price of a design system. Training of additional operators and/or training at the customer site can be obtained at an additional charge.

The Company has approximately 85 applications engineers, all of whom do hardware and software support. Customer support expenditures were approximately 6 percent of revenues in fiscal 1984.

MAJOR HISTORICAL MILESTONES

- November 1983--Introduced the Megalogician
- June 1983--First public offering; sold 2 million shares of common stock, netting proceeds of $28.56 million
- May 1983--Introduced the GATEMASTER
- April 1983--Authorized common stock increased to 50 million shares
- November 1982--Three-for-two stock split
- March 1982--Two-for-one stock split
- February 1982--Introduced the Logician
- November 1981--Shipped first Logician for beta-site testing
- August 1980--Daisy Systems commenced operations

In the development of the Daisy Engineering Environment, Daisy has utilized standard microprocessors, the Multibus interconnection, and the Ethernet Local Area Network product in its workstations. Please refer to Table 2 for more information on Daisy's system hardware.

APPLICATION SOFTWARE

Daisy's application-specific software includes the following:

- Maestro Shell--Provides same operating environment used by all other Logician systems, employing same command language and functionality
- Drawing Editor--Provides same graphics interface as the Logician; creation and manipulation of blocks, components, and busses

Daisy System Corporation

- Component Editor--Defines graphic shapes and electrical characteristics of nonstandard components not already existing in libraries of Personal Logician

- Component Library--Includes standard and ANSI/Milspec symbols for discrete and SSI-VLSI parts

- Techwriter--Screen editor and document formatter; provides ability to mix graphics and text

- Modeling System--Logic schematics are individually compiled and linked to form complete designs via three modules: Daisy Network Extraction (DANCE) to compile graphics files, Daisy Resolving Linker (DRINK) to logically join drawing pages, and Simulation Input Generation (SING) to do final formatting of design file

- Virtual Logic Analyzer (VLA)--User window to Megalogician simulator engine; allows user to interactively examine design's behavior as filtered simulation results are formatted

- Daisy Logic Simulator--Simulates at both board level and IC designs in any technology due to 12-state signal modeling capacity; entire state of design may be saved in a file for re-execution of saved environment

- Daisy Timing Verifier--24-state logic simulator for timing verification; recognizes 6 levels and 4 strengths

- Design Testability Analyzer--Determines testability of a circuit; may suggest alternative solutions to enhance circuit's testability

- Daisy Fault Simulator--Determines adequacy of test vectors in manufacturing test process to ensure that test pattern generated provides complete test of the design

- Daisy Tester Interface--Translates simulator output into a format recognizable to Automated Test Equipment (ATE)

- Daisy Layout Editor--Physically implements placement and routing functions

- Gate Array Interface Language (GAIL)--Encoding and characterizing of base arrays and cells; interfaces to manufacturer's place and route tools; communicates place and route specifications to manufacturer for fabrication

- Schematic to Layout Intermediate Data Evaluator (SLIDE)--Combines connectivity data from design schematic with the target array; generates a layout data base file that contains all information needed for placement and routing of selected array

- Mask Editor (MAX)--uses geometric shape to create mask representation using simple command syntax; text and parametric data may be attached at any layer

- Postprocessor--Used to verify accuracy of electrical characteristics and process parameters; Daisy has integrated ECAD Inc.'s DRACULA layout analysis package

- Daisy Hardware Compilers--Generate repetitive silicon structures such as PLAs and ROMs using a procedural definition or flow diagram; system constructs a layout format

- Factron Interface--Links CAE environment to Factron's test systems via a programmatic interface from CAE to ATE; test interface translates design data base from a Daisy workstation into Factron test system readable format

For information regarding configurations of application software supported on the Company's hardware, please refer to Table 3.

Table 1

R&D EXPENDITURES AS PERCENT OF REVENUE
(Millions of Dollars)

	1982	1983	1984
Revenue	$4.57	$17.47	$69.15
R&D Expense	$ 1.6	$ 4.1	$ 11.2
Percent of Revenue	35	24	16
Percent of Change	N/M	9	8

N/M = Not Meaningful

Source: Daisy Systems Corporation

Table 2

DAISY SYSTEMS HARDWARE

System	Manufacturer	Processor	Type	Application
Personal Logician XT	IBM	8088	PC	EDA
Personal Logician AT	IBM	80286	PC	EDA
Logician	prop.	80286	SA	EDA
Megalogician	prop.	80286	SA	EDA; simulation accelerator
Chipmaster	prop.	80286	SA	EDA for custom IC
Gatemaster	prop.	8086	SA	EDA Gate Array layout

Source: DATAQUEST

Table 3

DAISY SYSTEMS APPLICATION SOFTWARE CONFIGURATIONS

Software	Personal Logicians	Logician	Mega-logician	Gatemaster	Chipmaster
Maestro Shell	X				
Drawing Editor	X	X	X	X	X
Component Editor	X	X	X	X	X
Component Library	X		X	X	
Techwriter	X	X	X		
Modeling System		X	X	X	X
VLA			X		
Logic Simulator			X		
Timing Verifier			X		
Des. Test Analyzer			X		
Fault Simulator			X		
Tester Interface			X		
Layout Editor				X	
GAIL				X	
SLIDE				X	
MAX					X
Postprocessor					X

Source: DATAQUEST

Daisy Systems Corporation

Daisy Systems Corporation
139 Kifer Center
Sunnyvale, California 94086
Telephone: (408) 773-9111 Telex: 176105
(Millions of Dollars Except Per Share Data)

Balance Sheet (September 30)

	1981	1982	1983
Working Capital	$ 1.10	$ 7.68	$ 37.13
Long-Term Debt	$ 0.16	$ 0.55	$ 0.49
Shareholders' Equity	$ 1.18	$ 8.06	$ 39.20
After-Tax Return on Average Equity (%)	N/M	N/M	10.92

Operating Performance (Fiscal Year Ending September 30)

	1981	1982	1983
Revenue	$ -	$ 4.57	$ 17.47
U.S. Revenue	$ -	$ 3.82	$ 13.19
Non-U.S. Revenue	$ -	$ 0.75	$ 4.28
Cost of Revenue	$ -	$ 1.23	$ 4.07
R&D Expense	$ 0.66	$ 1.60	$ 4.09
SG&A Expense	$ 0.15	$ 1.65	$ 7.21
Pretax Income	$(0.79)	$ 0.24	$ 2.11
Pretax Margin (%)	N/A	5	12.10
Effective Tax Rate (%)	N/A	48.7	47.2
Net Income	$(0.79)	$ 0.23	$ 2.58
Average Shares Outstanding (Millions)	2.71	10.66	13.29
Per Share			
Earnings	$(0.29)	$ 0.02	$ 0.19
Dividend	$ 0.00	$ 0.00	$ 0.00
Book Value	$ 0.43	$ 0.76	$ 2.95
Price Range	N/A	N/A	$ 14-27
Total Employees	N/A	86	232

N/A = Not Available
N/M = Not Meaningful

Source: Daisy Systems Corporation Annual Report

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Daisy Systems Corporation

BACKGROUND

The Company

Daisy Systems Corporation was founded in August 1980 by Dr. Ram A. Banin, Mr. Rafael Chatav, Mr. Aryeh Finegold, Mr. Harvey C. Jones, Jr., and Mr. David A. Stamm. The company designs, manufactures, and sells computer-aided engineering design systems for the electronics industry. The term "computer-aided engineering" has been defined in several fashions by various organizations. DATAQUEST considers that a more correct title would be "electronic design automation" (EDA).

Daisy was the first company to provide EDA products for the IC design engineer on a standalone workstation-based product; it provides systems that work in a local area network. It is anticipated that most of these systems will be used in conjunction with mainframe computer facilities. The Company sells its product worldwide, primarily through a direct sales force.

Operations

Daisy develops and manufactures its own hardware and software and has put together a line of products that address integrated circuit design. The two major products are called The LOGICIAN and The GATEMASTER.

The first LOGICIAN product was shipped in November 1981 for Beta site testing; volume shipments began in February 1982. The GATEMASTER product was introduced in December 1982, and volume shipments commenced in July 1983. A LOGICIAN system is essentially a schematic-entry system that allows conceptual designs to be entered into a data base that will create logic diagrams and permit the design engineer to carry out various simulation and analysis operations on the data base. The GATEMASTER builds on the design information created by The LOGICIAN and is a gate array development product designed to support technologies of various suppliers of gate array circuits. The Company believes that it provides a turnkey facility for design and physical implementation of most MOS and bipolar gate array circuits.

Total revenue for Daisy Systems in fiscal 1982 was $4.6 million. Of this amount, $3.8 million were derived in the United States, and $0.75 million were derived from overseas sales. For the first six months of fiscal 1983, ended March 30, 1983, total revenue was $5.0 million, of which $2.98 million were derived domestically and $2.02 million were derived overseas.

Daisy Systems Corporation

Marketing

Daisy Systems sells hardware products directly and licenses rights to use the software products. It markets and services its hardware product through a direct organization in the United States and the United Kingdom. In addition, the Company has a direct sales office in Israel.

The systems are sold to engineers engaged in all forms of electronic circuit and system designs, primarily integrated circuit design. Currently, more than 50 companies have purchased products from Daisy Systems. Customers include manufacturers of 32-bit microprocessors, mainframe computers, local area network controllers, and digital private branch exchanges. Other applications include government-sponsored circuit design for military command and control systems, and consumer electronic systems including personal computers and video games.

Kanematsu Gosho in Japan, is currently Daisy's only distributor operation. The Company markets its products through several nonexclusive distributors, which are major suppliers of design automation and CAD tools. These distributors include Control Data Corporation and Scientific Calculations Incorporated. The Company anticipates increasing the number of direct sales and distributor outlets during fiscal 1983.

Daisy Systems has 10 domestic and 3 European regional technical centers, which service both sales offices and customer support centers.

The Company's initial sales strategy has been focused on industry or technology leaders in two principal market segments, LSI vendors and large electronic systems manufacturers. The decision-making activities of these recognized industry or technology leaders are closely monitored by other companies in the same industry or market segment.

In fiscal 1982, the Company's largest customer was Control Data Corporation, which accounted for 11.3 percent of that year's revenue. For the six-month period ended March 31, 1983, the Company's largest customers were British Aerospace Limited, Control Data Corporation, and Pacific Electronic Trade Corporation, a Japanese trading company. These companies accounted for, respectively, 12.9 percent, 11.7 percent, and 11.6 percent of net revenues. Both Control Data Corporation and Pacific Electronic Trade Corporation served as distributors of the Company's systems for this period.

The support of customers for hardware and software is carried out by field applications engineers. At the present time, the Company employs approximately 15 engineers for this function.

Daisy Systems Corporation

Research and Development

In fiscal 1982, Daisy Systems spent approximately 35 percent of net revenue, or $1.6 million, on R&D and product development. For the first six months of fiscal 1983, the Company spent approximately 31 percent of net revenue, or $1.56 million. The Company's basic product development strategy is to design and develop particular hardware and software items for specialty features to enhance the performance of its system, but otherwise to purchase commodity items such as tape drives, disks, and compilers.

Product development activity is concentrated in the following three basic areas. They are:

- Developing specialized application software for specific user groups

- Designing, developing, and manufacturing advanced hardware stations, which consist of central processor units, I/O controllers, and local area network controllers

- Developing high-performance systems software such as general purpose graphic and data base packages

More than 50 software engineering professionals are engaged in developing new applications software. In its R&D efforts, the Company uses the LOGICIAN product to develop new application processing software. In the design workstation hardware, the Company integrates various standard submodules such as Ethernet and disk controllers, disk drives, display controllers, deflection electronics, DC power supplies, and complex VLSI devices.

Manufacturing

The Company manufactures many of the components of its design stations. Operations for manufacturing consist of assembly, test, and quality control of components, parts, and subassemblies. To reduce labor and equipment requirements, the Company contracts substantial portions of the assembly, including sheet-metal fabrication, printed circuit board stuffing, and wave soldering.

The Company maintains manufacturing facilities of approximately 60,000 square feet in two buildings in Sunnyvale, California.

Daisy Systems Corporation

Organization

As of March 31, 1983, the Company employed 136 persons full-time. Approximately 50 employees are engaged in designing and developing systems software and hardware. The rest are predominantly sales and customer support personnel.

The Company's executive offices are located in Sunnyvale, California, where it leases approximately 65,000 square feet; these leases expire in February 1988. In addition, Daisy leases a number of small offices elsewhere in the United States, the United Kingdom, and West Germany; these offices are all on short-term leases.

CAD/CAM BUSINESS

Daisy has structured its software products around hardware systems based on a proprietary central processing system that incorporates the Intel 8086 family of components. The central microprocessor unit is the IAPX86 product from Intel; in addition, it is possible to purchase the 8087 Arithmetic Coprocesser with the Daisy system. This design approach makes Daisy a vertical integration CAD/CAM company in the sense that it constructs its own system from basic components, as opposed to some of its competitors that use industry standard computer systems. Daisy also supports an Ethernet-based local area network to give the end user a distributed system of standalone design systems. The Company believes that by developing its own hardware, it can optimize the integration of hardware and software to achieve high performance of the overall system. This approach also gives the Company greater pricing flexibility, allowing it to avoid a third-party hardware supplier and therefore higher ultimate prices to the end user. The Company is also able to protect itself from decreased margins when prices have to be cut due to competitive pressures.

Software Products

The true value-added aspect of the Daisy system, however, is in the software products offered to the end users. These products comprise The LOGICIAN series for logic design verification and modeling and The GATEMASTER gate array design system, which allows the user to automatically lay out and develop gate array systems.

LOGICIAN

The LOGICIAN product utilizes schematic entry graphic universal logic symbols that are familiar to any electrical engineer. It provides a single access method to the complete spectrum of existing design automation tools. The four major subsystems of the LOGICIAN product are:

- o A hierarchical design data base

- o A schematic entry editor

- o Daisy Verification Support System (DVSS), which was introduced in June 1982, and is used to verify and analyze the engineer's design. It has the following subcomponents:

  - The Daisy Logic Simulator (DLS), an interactive 12-state logic simulator that optimizes gate level simulation and efficiently evaluates logic expressions. It is an interactive product that allows the user to request various conditions and modes during any part of a simulation process. It can also perform such operations as changing, loading, and saving the contents of RAMs, ROMs, and PLAs.

  - Daisy Timing Verifier (DTV), which performs comprehensive worst-case timing analysis. DTV was the first commercial implementation of the Scald timing verifier developed by Lawrence Livermore Laboratories under a third-party government contract. Daisy has extended the original Scald timing verifier to handle 21-state operation so as to model MOS/LSI more accurately.

  - SPICE Master, a circuit simulation function using a derivative of the widely accepted SPICE version 2G.5 program with the optional 80-bit hardware floating point coprocessor from Intel. The Company claims that such an option provides mainframe-like performance and accuracy. SPICE Master provides detailed DC/AC and transient analysis on all types of bipolar and MOS digital and analog circuits.

- o Daisy Modeling System (DMS), which will extract from the already created data base the net list information that can then be submitted to a mainframe design automation program.

Also offered under the LOGICIAN banner is a group of software development tools that allow the IAPX family of microprocessors incorporated in the Daisy design systems to access a wide set of programming languages and other application software packages. Daisy has implemented on its system the universal development interface authored by Intel. In addition, the Company offers optional products such as the PLM86, Pascal 86, and FORTRAN 86 programming languages; at some point in the future it will offer a C-compiler.

GATEMASTER

The GATEMASTER system is the most recent product announced by Daisy. It builds upon all the functions of The LOGICIAN and is specifically targeted at gate array technology design. The Company claims that GATEMASTER allows a large system house to take advantage of LSI circuits without training its engineers in VLSI design or assuming the inherent risks of long lead times and high development costs associated with full-custom VLSI.

GATEMASTER provides a turnkey facility for the design and physical implementation of MOS and bipolar gate array integrated circuits. Essentially it takes the finished logic information from LOGICIAN and uses it as a basis for physical placement and routing of the gate array. This activity requires the use of design rules by gate array manufacturers in conjunction with the GATEMASTER software. Such design information or design rules of the gate array manufacturers must either be obtained by the customer or supplied as an optional library by Daisy Systems. At this point, a small number of gate array libraries are available from Daisy to its end users.

Daisy Hardware

Daisy has announced the Daisy Engineering Environment, a collection of integrated, distributed hardware systems that will run LOGICIAN and GATEMASTER. The heart of the design system is a standalone central processing subsystem that contains an Intel 8086 which is a 10-Megahertz, 16-bit microprocesser with 768 Kbytes of dynamic RAM. Options include expansion of RAM to 1.5 Mbytes, and an optional 80-bit floating point coprocessor, the 8087. Another component of this system is the graphics processor that Daisy has developed. In addition, every design system has a dedicated 10-Mbyte Winchester hard disk with a 40-Mbyte Winchester as an option. (By mid-1983, an 80-Mbyte Winchester will also be an option.) For archival storage and design transport, a 1.2-Mbyte floppy disk is provided. The components of Daisy's Engineering Environment system are tied together using the Ethernet network environment, which in addition to design stations can accommodate a file server type of system that would have large disk capabilities. Future features available in late 1983 include a 475-Mbyte Winchester drive and multiple purpose multiprotocol communications interfaces. At present, the Company offers RS-232C or RS-422 serial links. Optional communications interfaces available today include IBM 2780, 3780 remote job entry emulation, and a Digital Equipment Corporation DR11W parallel interface. In addition, the LOGICIAN hardware systems all support parallel interfaces to high-speed printer plotters, which are available from the Company.

Daisy Systems Corporation

APPLICATIONS

The products provided by Daisy are for use primarily in integrated circuit design, although some printed circuit board applications have been carried out on Daisy systems. Daisy calls the application of its systems "Computer Aided Engineering," but believes this application should more correctly be called "electronic design automation," as it does not encompass all the engineering functions involved in the production of an integrated circuit. Daisy Systems is growing towards a full CAE environment, but this development is still somewhere off in the future.

Daisy System Corporation

The Company has approximately 85 applications engineers, all of whom do hardware and software support. Customer support expenditures were approximately 6 percent of revenues in fiscal 1984.

MAJOR HISTORICAL MILESTONES

- November 1983--Introduced the Megalogician
- June 1983--First public offering; sold 2 million shares of common stock, netting proceeds of $28.56 million
- May 1983--Introduced the GATEMASTER
- April 1983--Authorized common stock increased to 50 million shares
- November 1982--Three-for-two stock split
- March 1982--Two-for-one stock split
- February 1982--Introduced the Logician
- November 1981--Shipped first Logician for beta-site testing
- August 1980--Daisy Systems commenced operations

PRODUCTS

In the development of the Daisy Engineering Environment, Daisy has utilized standard microprocessors, the Multibus interconnection, and the Ethernet Local Area Network product in its workstations. Please refer to Table 2 for more information on Daisy's system hardware.

Application Software

Daisy's application-specific software includes the following:

- Maestro Shell--Provides same operating environment used by all other Logician systems, employing same command language and functionality
- Drawing Editor--Provides same graphics interface as the Logician; creation and manipulation of blocks, components, and busses

Daisy System Corporation

- Component Editor--Defines graphic shapes and electrical characteristics of nonstandard components not already existing in libraries of Personal Logician

- Component Library--Includes standard and ANSI/Milspec symbols for discrete and SSI-VLSI parts

- Techwriter--Screen editor and document formatter; provides ability to mix graphics and text

- Modeling System--Logic schematics are individually compiled and linked to form complete designs via three modules: Daisy Network Extraction (DANCE) to compile graphics files, Daisy Resolving Linker (DRINK) to logically join drawing pages, and Simulation Input Generation (SING) to do final formatting of design file

- Virtual Logic Analyzer (VLA)--User window to Megalogician simulator engine; allows user to interactively examine design's behavior as filtered simulation results are formatted

- Daisy Logic Simulator--Simulates at both board level and IC designs in any technology due to 12-state signal modeling capacity; entire state of design may be saved in a file for re-execution of saved environment

- Daisy Timing Verifier--24-state logic simulator for timing verification; recognizes 6 levels and 4 strengths

- Design Testability Analyzer--Determines testability of a circuit; may suggest alternative solutions to enhance circuit's testability

- Daisy Fault Simulator--Determines adequacy of test vectors in manufacturing test process to ensure that test pattern generated provides complete test of the design

- Daisy Tester Interface--Translates simulator output into a format recognizable to Automated Test Equipment (ATE)

- Daisy Layout Editor--Physically implements placement and routing functions

- Gate Array Interface Language (GAIL)--Encoding and characterizing of base arrays and cells; interfaces to manufacturer's place and route tools; communicates place and route specifications to manufacturer for fabrication

Data General Corporation

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(Millions of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF SEPTEMBER 1984

	1980	1981	1982	1983	1984	CAGR 1980-1984
BALANCE SHEET DATA						
Working Capital	$ 337.3	$ 375.6	$ 397.4	$ 421.4	$ 469.0	8.6%
Long-Term Debt	$ 144.7	$ 144.7	$ 139.2	$ 138.9	$ 134.9	(1.7%)
Shareholders' Equity	$ 318.6	$ 382.3	$ 429.0	$ 469.0	$ 594.0	16.9%
After-Tax Return on Average Equity	19.2%	26.5%	11.5%	9.9%	28.0%	
OPERATING PERFORMANCE						
Revenue	$ 653.9	$ 736.9	$ 805.9	$ 828.9	$1,160.8	15.4%
U.S. Revenue	$ 444.9	$ 512.1	$ 570.3	$ 568.7	$ 821.8	16.6%
Non-U.S. Revenue	$ 209.0	$ 224.8	$ 235.6	$ 260.2	$ 339.9	12.9%
Cost of Goods Sold	$ 328.9	$ 382.6	$ 457.4	$ 476.4	$ 659.1	19.0%
Gross Margin	$ 325.0	$ 354.3	$ 348.5	$ 352.5	$ 501.7	11.5%
Expenses	$ 218.2	$ 273.0	$ 312.6	$ 316.0	$ 399.1	16.3%
R&D Expenses	$ 65.6	$ 74.6	$ 84.5	$ 84.7	$ 101.5	11.5%
SG&A Expense	$ 152.5	$ 198.4	$ 228.1	$ 231.3	$ 297.5	18.2%
Operating Income	$ 106.8	$ 81.4	$ 35.9	$ 36.5	$ 102.7	(1.0%)
Interest Expense	($ 10.1)	($ 19.7)	($ 17.6)	($ 16.8)	($ 16.7)	13.5%
Interest Income	$ 4.6	$ 13.9	$ 18.7	$ 21.3	$ 23.7	50.9%
Income before Tax	$ 121.4	$ 114.9	$ 72.2	$ 74.6	$ 143.0	4.2%
NOTE: Pretax Margin	18.6%	15.6%	9.0%	9.0%	12.3%	
Taxes	($ 46.6)	($ 34.7)	($ 17.2)	($ 17.9)	($ 42.4)	(2.4%)
NOTE: Effective Tax Rate	(38.4%)	(30.2%)	(23.8%)	(23.9%)	(29.6%)	
Net Income after Tax	$ 54.7	$ 50.7	$ 24.7	$ 23.1	$ 83.3	11.1%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	$ 21.0	$ 21.2	$ 21.7	$ 24.0	$ 25.9	5.3%
Per Share Data						
Earnings	$ 5.20	$ 4.78	$ 2.28	$ 0.94	$ 2.60	(15.9%)
Book Value	$ 15.15	$ 18.03	$ 19.77	$ 19.54	$ 22.93	10.9%
Price Range (Low)	46-	40 1/2-	20 1/4-	11 3/4-	31 1/2-	
(High)	87 3/4	81 3/8	58 7/8	41 3.8	59 1/2	
TOTAL EMPLOYEES	14,370	14,625	15,210	14,855	17,695	5.3%
Revenue Per Employee	$ 0.0	$ 0.1	$ 0.1	$ 0.1	$ 0.1	9.6%

Source: Data General Corporation
Annual Report and Form 10K

Data General Corporation

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LINE ITEMS AS A PERCENT OF REVENUE

	1979	1980	1981	1982	1983
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	68.0%	69.5%	70.8%	68.6%	70.7%
Non-United States	32.0%	30.5%	29.2%	31.4%	29.3%
Costs of Goods Sold	$ 0.5	$ 0.5	$ 0.6	$ 0.6	$ 0.6
Gross Margin	$ 0.5	$ 0.5	$ 0.4	$ 0.4	$ 0.4
Expenses	33.4%	37.0%	38.8%	38.1%	34.4%
R&D Expense	10.0%	10.1%	10.5%	10.2%	8.7%
SG&A Expense	23.3%	26.9%	28.3%	27.9%	25.6%
Other Expense	0.0%	0.0%	0.0%	0.0%	0.0%
Operating Income	16.3%	11.0%	4.5%	4.4%	8.8%
Interest Expense	(1.5%)	(2.7%)	(2.2%)	(2.0%)	(1.4%)
Interest Income	0.7%	1.9%	2.3%	2.6%	2.0%
Other Income (Expense)	0.0%	0.0%	0.0%	0.0%	0.0%
Income before Tax	18.6%	15.6%	9.0%	9.0%	12.3%
Taxes	(7.1%)	(4.7%)	(2.1%)	(2.2%)	(3.6%)
Net Income after Tax	8.4%	6.9%	3.1%	2.8%	7.2%

Data General Corporation

THE COMPANY

Background

Data General Corporation was incorporated in the state of Delaware on April 15, 1968. The Company designs, manufactures, and markets general-purpose minicomputers, as well as associated software and peripheral equipment.

Since its inception, Data General has installed more than 155,000 systems worldwide.

Highlights

- September 1984--The Company introduced the DATA GENERAL/One Personal System, a 10-pound portable computer system.

- September 1984--Data General unveiled the Ada Development Environment (ADE), an interactive source-level Ada software debugger.

- May 1984--The Company announced the availability of several graphics products based on Data General's 32-bit ECLIPSE/MV Family of superminicomputers:

  - GW/8000 Graphics Workstation

  - GW/10000 Graphics Workstation

  - ANSI and ISO-Compliant GKS Level 2B

Organization

Data General focuses its efforts on four basic markets: industrial, business, personal automation, and the newly established Federal Systems Division, which serves the United States Government market. The primary focus of this corporate profile will be the Industrial Automation Division of Data General's operations, which centers its technical product line in the CAD/CAE/CAM industry.

Data General's corporate headquarters are located in Westboro, Massachusetts. The Company employs 17,677 people worldwide, an increase of 19 percent over 1983.

Data General Corporation

Research and Development

The Company invested more than $400 million in a product research and development (R&D) effort that resulted in product introductions and enhancements in the following areas:

- Graphics workstations for business and industrial applications
- Comprehensive electronic office automation
- Additional features for Desktop Generation computers
- The DATA GENERAL/One

Data General has formed a Board of Scientific Advisors to strengthen the Company's product development efforts. Comprised of internationally recognized scholars and scientists, this board will advise the Company regarding product strategies and emerging technologies.

The Company maintains a 174,000-square-foot facility in the Cary, North Carolina, Research Triangle Park for advanced system research and development. An R&D division has been added to the Company's facility in Japan.

Manufacturing

Increases in equipment sales in 1984 led to investments by Data General in new facilities and automation processes to improve manufacturing productivity and reduce costs over the next several years.

Please refer to Table 1 for location and size of Data General's manufacturing facilities.

The Company's new facilities are located in Durham, New Hampshire; Singapore; and the Philippines. Production in these facilities will begin within the next eighteen months.

Table 1

MANUFACTURING FACILITIES

Location	Purpose	Square Feet
Southboro, MA	Systems integration; central processor test and assembly; metal fabrication and machining; software reproduction; publications and printing	540,000
Westbrook, ME	Peripherals manufacturing; metal fabrication	392,000
Portsmouth, NH	PCB assembly and test; central processing assembly and test	235,000
Apex, NC	PCB fabrication, assembly, and test	205,000
Austin, TX	Peripheral development and manufacturing; power supply manufacturing	285,000
Sunnyvale, CA	Semiconductor development and manufacturing	95,000
Gyoda, Japan	PCB assembly and test; mass storage manufacturing; system integration; R&D	64,000
Hong Kong, BCC	Terminal assembly, PCB assembly and test	82,000
Manila, Philippines	PCB assembly and test power supply manufacturing	36,000
Bangkok, Thailand	Semiconductor assembly; cable and harness manufacturing; peripheral assembly and test	50,000

Source: Data General Corporation

Data General Corporation

Marketing and Sales

Data General markets its products domestically through original equipment manufacturer (OEM) agreements, industrial distributors, a direct sales force, and a dealer network. The Company has channels of distribution in over 100 cities in the following states:

Alabama	Kentucky	North Carolina
Arizona	Louisiana	Ohio
Arkansas	Maryland	Oklahoma
California	Massachusetts	Oregon
Colorado	Michigan	Pennsylvania
Connecticut	Mississippi	Rhode Island
Florida	Missouri	Tennessee
Georgia	Montana	Texas
Hawaii	Nebraska	Utah
Idaho	Nevada	Virginia
Illinois	New Jersey	Washington
Indiana	New Mexico	Wisconsin
Iowa	New York	

In 1984, the Company extended its multichannel sales approach to include major cooperative marketing agreements with several telecommunications firms capable of handling large volumes of Data General products. These firms specifically handle the Company's office automation products and ECLIPSE/MV Family of computers.

Data General's North American Sales Division has implemented a 36-week training program in sales and systems for recently hired university graduates. One hundred and twenty new salespeople graduated from the program into Data General's sales organization during 1984.

International Sales

Revenues from international sales (including United States direct export sales) represented approximately $380 million in 1984, an increase of 31 percent from the 1983 international revenues of $284 million.

Data General Corporation

Overseas sales represented 32 percent of the Company's total revenues for 1984, as compared to 24 percent in 1983. Data General has overseas offices in the following countries:

Australia	Ireland	Spain
Austria	Italy	Sweden
Belgium	Japan	Switzerland
Brazil	Netherlands	Thailand
Chile	New Guinea	Trinidad
Denmark	New Zealand	United Kingdom
Federal Republic of Germany	Puerto Rico	Venezuela
France	Scotland	
Hong Kong	Singapore	

The Company has international representatives and distributors in the following countries:

Argentina	Ivory Coast	Peru
Bolivia	Jordan	Philippines
Ecuador	Korea	Portugal
Egypt	Kuwait	Saudi Arabia
Finland	Lebanon	South Africa
Greece	Malaysia	Sri Lanka
Guatemala	Mexico	Tunisia
India	Nigeria	Turkey
Indonesia	Norway	United Arab Emirates
Israel	Paraguay	Zimbabwe

Support

Data General has an Educational Services group that provides hardware and software training at seven centers in the United States and nine overseas centers. The Company will also provide training at the customer site.

Data General has three types of service agreements: on-call service contract, on-call service agreement, and priority-response/OEM facility agreement.

The On-Call Service Contract is a preventative and remedial contract. After an initial time frame of six months, the customer may continue the contract indefinitely, subject to a 90-day written notice of cancellation on the part of the customer or the Company. The contract covers parts and labor.

The On-Call Service Agreement begins with an initial period of not less than 90 days and continues for an indefinite period of time, subject to a 60-day written notice of cancellation on the part of the customer or the Company. The agreement covers parts and labor for preventative and remedial service. The Company will attempt to respond to a remedial service call within four hours if the installation location is within 50 miles of a Data General service center.

Charges for the On-Call Service Contract and the On-Call Service Agreement are the same: an initial monthly charge is established at the time the contract begins, with a minimum of $150 a month for customer sites located 100 miles or less from a service center and $225 a month for customer sites located more than 100 miles from a service center.

Data General's OEM facility agreement is available to a customer who has bought equipment under a Data General OEM Discount Agreement and installed it at the customer's facility. In this instance, the customer must provide the Company with a blanket purchase order to cover the services listed in the agreement; fees are established at the time the contract begins. The OEM agreement is renewable for periods of not less than 3 months and not more than 12 months. The Company will respond to service calls within one working day. This agreement also covers parts and labor for remedial and preventative maintenance.

CAD/CAM PRODUCTS

Hardware

Data General's Industrial Automation products are based on the ECLIPSE/MV Family of 32-bit systems. They run on the MS-DOS, VENIX, and AOS/VS operating systems.

For more information regarding Data General's systems, please refer to Table 2.

Table 2

DATA GENERAL'S TECHNICAL PRODUCTS

Name	Manufacturer	Word Size	Number of Workstations
Systems			
ECLIPSE MV/4000	Proprietary	32-bit	Up to 64
ECLIPSE MV/8000 C	Proprietary	32-bit	Up to 128
ECLIPSE MV/8000 II	Proprietary	32-bit	Up to 128
ECLIPSE MV/10000	Proprietary	32-bit	Up to 192
Name	**Type**	**Resolution**	**Colors**
Workstations			
GDC/1000	H-D	1,280 x 1,024	256
Dasher G500	H-D	640 x 480	16
GW/4000	H-D	1,280 x 1,024	16 million
DS/4000	SA	1,024 x 1,024	1
DS/4200	SA	1,024 x 1,024	16
DATA GENERAL/ONE	Portable	25 x 80 LCD	1

H-D = Host-dependent
SA = standalone

Source: DATAQUEST

Software

There are more than 150 software packages which run on the ECLIPSE/MV Family of computer systems for three segments of the CAD/CAM Industry:

- AEC
- Electronic
- Mechanical

These packages are available through Data General's OEM and Independent Software Vendor Programs.

Data General Corporation

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Balance Sheet (September 30)

	1979	1980	1981	1982	1983
Working Capital	$244.18	$362.22	$417.46	$442.44	$421.39
Long-Term Debt	$ 62.41	$144.70	$144.65	$139.23	$138.88
Shareholders' Equity	$251.64	$318.57	$382.25	$429.04	$468.99
After-Tax Return on Average Equity (%)	22.48	19.18	14.46	6.00	5.15

Operating Performance (Fiscal Year Ending September 30)

	1979	1980	1981	1982	1983
Revenue	$507.48	$653.89	$736.87	$805.91	$828.90
U.S. Revenue	$370.04	$444.85	$512.11	$570.29	$568.69
Non-U.S. Revenue	$137.44	$209.04	$224.76	$235.62	$260.21
Cost of Revenue	$251.19	$328.94	$382.56	$457.41	$476.39
R&D Expense	$ 50.62	$ 65.64	$ 74.57	$ 4.54	$ 84.66
SG&A Expense	$114.48	$152.51	$198.39	$228.05	$231.31
Pretax Income	$ 93.06	$101.30	$ 75.55	$ 37.05	$ 41.01
Pretax Margin (%)	18.34	15.49	10.25	5.00	4.95
Effective Tax Rate (%)	46.47	46.01	45.98	46.00	43.60
Net Income	$ 49.81	$ 54.69	$ 50.66	$ 24.66	$ 23.14
Average Shares Outstanding (Millions)	10.34	10.52	10.60	10.80	22.64**
Per Share					
Earnings	$ 4.82	$ 5.20	$ 4.78	$ 2.28	0.94**
Book Value*	$ 29.94	$ 30.84	$ 36.25	$ 38.95	$ 20.72
Price Range*	$52 1/4-74 1/2	$ 46-87 3/4	$40 1/2-81 3/8	$20 1/4-58 7/8	$11 3/4-41 3/8**
Total Employees	13,380	14,370	14,625	15,210	14,855

*Calculated using year-end shares outstanding of 10,090,000 in 1979, 10,328,000 in 1980, 10,545,000 in 1981, 11,016,000 in 1982, and 22,641,000 in 1983

**Adjusted to reflect two-for-one stock split declared October 26, 1983

Source: Data General Corporation
Annual Reports and Forms 10-K
DATAQUEST

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Data General Corporation

THE COMPANY

Background

Data General Corporation (DG) was founded by Edson D. deCastro, Henry Burkhardt III, Herbert J. Richman, Frederick R. Adler, and Richard Sogge. The Company, which was incorporated in Delaware on April 15, 1968, designs, manufactures, and markets general-purpose minicomputers (GPMCs). In 1973, Data General listed its common stock on the New York Stock Exchange.

The Company shipped its first minicomputer, called the NOVA, in 1968. Since its inception, Data General has installed more than 132,600 computer systems worldwide.

Operations

Data General manufactures computer products for three application areas: industrial and scientific, integrated information processing, and small business applications. In fiscal 1983, Data General reported revenue of $828.9 million, compared with $805.9 million in 1982, representing a 3 percent increase. Cost of revenue increased 4 percent, from $457.4 million in fiscal 1982 to $476.4 million in fiscal 1983, and net income decreased from $24.7 million in fiscal 1982 to $23.1 million in fiscal 1982.

As Data General's installed base has grown, service and other revenues have represented an increasing proportion of total revenue. For fiscal years 1981, 1982, and 1983, service and other revenues represented 16, 23, and 28 percent, respectively, of total revenue. During these same fiscal years, service revenues grew each year by 42, 27, and 24 percent, respectively.

Corporate headquarters are located in Westboro, Massachusetts. Data General manufactures computers, peripheral equipment, and components in facilities in Maine, New Hampshire, Massachusetts, North Carolina, Texas, California, Japan, Hong Kong, Thailand, and the Philippines.

International Operations

Data General conducts its foreign business primarily in Western Europe, Canada, Japan, and Australia. Table 1 traces the history of the Company's U.S. and non-U.S. sales from fiscal 1970 through fiscal 1983. In fiscal 1983, non-U.S. revenues grew 9 percent. U.S. revenues decreased less than 1 percent in 1983.

Data General Corporation

Table 1

Data General Corporation
DISTRIBUTION OF U.S. AND NON-U.S. SALES

	United States			Non-United States			Total	
Fiscal Year (Oct. 1-Sept. 30)	Sales (Millions of Dollars)	Percent Growth	Percent of Total	Sales (Millions of Dollars)	Percent Growth	Percent of Total	Sales (Millions of Dollars)	Percent Growth
1970	$ 5.9	N/A	84%	$ 1.1	N/A	16%	$ 7.0	N/A
1971	$ 11.8	100%	77%	$ 3.5	218%	23%	$ 15.3	118%
1972	$ 25.2	114%	74%	$ 8.8	151%	26%	$ 34.0	122%
1973	$ 44.1	75%	74%	$ 15.5	76%	26%	$ 59.6	75%
1974	$ 67.9	54%	73%	$ 25.1	62%	27%	$ 93.0	56%
1975	$ 76.8	13%	64%	$ 42.8	71%	36%	$119.6	29%
1976	$106.5	39%	60%	$ 72.3	69%	40%	$178.8	49%
1977	$173.6	63%	68%	$ 81.1	12%	32%	$254.7	43%
1978	$281.9	62%	74%	$ 98.0	21%	26%	$379.9	49%
1979	$370.0	31%	73%	$137.5	40%	27%	$507.5	34%
1980	$444.9	20%	68%	$209.0	52%	32%	$653.9	29%
1981	$512.1	15%	69%	$224.8	8%	31%	$736.9	13%
1982	$570.3	11%	71%	$235.6	5%	29%	$805.9	9%
1983	$568.7	(1%)	69%	$260.2	9%	31%	$828.9	3%

N/A = Not Applicable

Source: Data General Corporation
Annual Reports

Data General established a subsidiary in Finland in 1983, acquiring Stromberg Data of Helsinki, its former distributor.

The Company maintains four overseas facilities. A Company-owned, 70,000-square-foot facility in Hong Kong is used for semiconductor assembly and test, as well as for terminal assembly and system integration. A leased, 36,000-square-foot facility in Manila, the Philippines, is used for printed circuit board and semiconductor assembly. A leased, 34,000-square-foot facility in Bangkok, Thailand, is used for core memory and semiconductor assembly. A Company-owned, 64,000-square-foot facility in Gyoda, Japan, is used for printed circuit board assembly and test, mass storage manufacturing, systems integration, and research and development.

Data General Corporation

Marketing and Distribution

The Company markets its products through a variety of distribution channels using principally its own sales engineers in Company offices located throughout the world. In addition to selling directly to end users, the Company sells to original equipment manufacturers (OEMs), who combine the Company's products with other equipment, such as microfiche developers, body scanning equipment, and electronic cash registers, for resale to the end user. Data General also sells products to systems integrators and small business suppliers, who add application software to the Company's computer systems before reselling them, and who may also provide assistance in installing and maintaining the systems. Certain microprocessor products and terminals are sold through distributors, who stock them for immediate off-the-shelf delivery to the customer. In addition, certain small business systems are sold to independent dealers who in turn market to the small business community.

During 1983, Data General began establishing a network of independent computer dealers to augment the Company's sales force in marketing the DESKTOP GENERATION family of computers. Dealer selection is based on previous performance, financial strength, successful completion of extensive Company training programs, and effective use of merchandising support. The program includes financial incentives for participating dealers. The Company's general policy is to sell, rather than lease, its products. Customers who prefer to lease are generally financed by third-party lessors.

The Data General Business Group, responsible for the Company's systems level development and marketing operations, underwent reorganization during fiscal 1983 and now consists of five divisions directed at the Company's three major markets. The Information Systems Division (ISD) markets computer systems used by large organizations in commercial applications, with the primary emphasis on integrated office automation and distributed data processing. In addition, the former Small Business Systems Business Unit, which marketed systems for commercial OEMs, systems integrators, and end users in the small business market, has been integrated into the ISD. This group sells primarily products from the ECLIPSE information systems family and the Commercial Systems (CS) small business systems family. The former Technical Products Business Unit, now the Technical Products Division (TPD), markets products for technical OEMs, end users, and systems integrators in the industrial, scientific, and technical markets. Products marketed by the TPD include products from the NOVA, scientific ECLIPSE, and microNOVA families. The newly established Desktop Division combines marketing, business planning, and support functions to focus the Company's efforts in the desktop systems market, which includes industrial, scientific and technical, and small business and general office applications. The Desktop Division markets products from the DESKTOP GENERATION product family. The Systems Development and Semiconductor Divisions design and develop the computer systems, software, and semiconductor components for the ISD, TPD, and Desktop Division.

The Company is not dependent upon any one customer, or a very few customers, for a material part of its business. Sales made directly to various agencies of the United States Government represented less than 3 percent of the Company's consolidated total revenues. No single customer is believed to have accounted for more than 5 percent of consolidated total revenues.

Sales Organization

Sales offices are located in 110 U.S. and Canadian locations and 70 locations in Europe, the Far East, and Latin America.

Data General's sales representatives are compensated through a combination of base salary and commissions paid on an increasing sliding scale. Commissions are paid only after the customer has paid in full for the equipment.

Data General's sales force is composed mainly of persons with electrical engineering backgrounds or with experience with another minicomputer company. Currently, the sales force receives a two-week introductory course that attempts to cover the entire DG product line. In all of its larger sales offices, DG has divided its sales force into three parts--industrial and scientific, commercial, and Federal Government. All sales representatives report to the branch manager.

Maintenance, Service, and Training

The Company extends a limited service and parts warranty on all equipment sold and offers several types of maintenance services and contracts at additional charges. Warranty and other maintenance services are performed by service employees located in various offices throughout the world.

Data General also provides various services related to the installation and operation of its computer systems and software. Systems engineers provide systems and software installation support and provide continuing software support to customers through a variety of contract service programs. The Company's Systems Division designs custom applications software under contract to individual customers. Systems Division services include application analysis; software design, development, and testing; installation; and specialized user training. The Special Systems Group designs custom hardware products under contract to individual customers. Customer training related to the Company's computer systems and software is provided at Company training locations or at the customer's own facilities. Data General operates regional training centers in Atlanta, Boston, Chicago, Dallas, Los Angeles, Washington, D.C., six European countries, Australia, and New Zealand.

Data General introduced its Maximum Uptime Service with the first shipments of the ECLIPSE MV/4000 and MV/10000 systems. This service allows customers to select guaranteed levels of uptime from 96 through 99 percent. Critical Response Service, new with the ECLIPSE MV/10000, provides guaranteed uptime of 96 percent, as well as two-hour response to service requests, 12 hours a day.

Research and Development

Company-sponsored research and development expenditures in fiscal 1983 were $84.7 million. Research and development work is done primarily in the following areas: systems software and application's software; integrated circuit technology; microprocessor design; basic minicomputer design; small business systems design; mass storage development, terminal, and workstation products; and customer-contracted special product design.

Employees

During fiscal 1983, the number of employees decreased to 14,855 persons from 15,210 persons in 1982.

Financial Highlights

During fiscal 1983, selective price decreases of up to 18 percent were announced on certain ECLIPSE MV/8000 models, and prices on 1- and 2-Mbyte 32-bit ECLIPSE add-on memory boards were reduced approximately 45 percent.

On October 26, 1983, the Company declared a two-for-one stock split in the form of a 100 percent stock dividend on its common stock to shareholders of record as of November 7, 1983.

Data General Corporation

LINES OF BUSINESS

Computers

Data General currently has six product families: NOVA, ECLIPSE information systems, scientific ECLIPSE systems, microNOVA microproducts, Commerical Systems small business systems, and DESKTOP GENERATION Systems.

Members of the NOVA family of computer systems use the same central processor and peripheral devices, although the performance and price of each model differ. All are 16-bit binary computers using medium-, large-, and very large-scale integration. Although new or improved models are continually in development, parts, service, and additional equipment for all models are still being offered. The NOVA family currently consists of five models.

ECLIPSE computers utilize a more powerful instruction set than the NOVA family, are capable of using virtually all of the Company's peripheral equipment, and are capable of executing most programs that operate on the NOVA family. All are 16-bit or 32-bit computers using medium-, large-, and very large-scale integration. ECLIPSE information systems presently consist of three 16-bit models and five 32-bit models, including the MV/8000II, MV/8000C, and MV/10000, three 32-bit models introduced in 1983. Scientific ECLIPSE systems presently include seven 16-bit models and five 32-bit models.

The microNOVA is a high-performance, microprocessor-based family with 16-bit NOVA computer capabilities. There are currently four models in the microNOVA family.

There are nine members of the CS computer family. All are packaged systems that include a central processor from the microNOVA, NOVA, or ECLIPSE product families in a basic configuration with disk storage, line printer, and a video display terminal. All systems are designed to provide interactive data entry, inquiry, and update with the industry-standard COBOL language.

The DESKTOP GENERATION family presently consists of four models, the 10, 10SP, 20, and 30, all introduced in 1983. These products are desktop packaged systems that include a microECLIPSE-based central processor, main memory, input keyboard, video display, floppy diskette storage, and line printer. The models 10 and 10SP also include a closely coupled Intel 8086 processor and are capable of utilizing both Data General and industry-standard operating systems. All models may be utilized as standalone computers, as multiuser systems with up to four terminals, or as nodes linked to a Data General or other host system.

Data General Corporation

All of the Company's computer systems differ in speed, availability of certain processor features, and the number of available subassembly slots that may be used to accommodate peripheral controller subassemblies.

Data General also sells a wide variety of peripheral equipment for use with its computers. Peripheral equipment manufactured by the Company includes video display terminals, magnetic disk memories, magnetic tape equipment, terminal printers, communication controllers and multiplexers, and analog-to-digital converters. Peripheral equipment acquired from other manufacturers for use with the Company's computer systems includes magnetic disk memories, magnetic tape equipment, teletypewriters, line printers, plotters, and digital-to-analog converters. The Company also manufactures peripheral controller subassemblies and related electronic equipment for connecting its computers to standard teletypewriters, standard data communication equipment, and computer systems manufactured by others, including IBM's System/360 and System/370 lines of computers. Data General designs and manufactures certain electronic equipment, including peripheral controller subassemblies, for use with electro-mechanical peripheral equipment it produces or purchases from others.

Software

Data General has developed and offers an extensive library of systems software products for use with its computer systems, including data base management and communications software for industry-standard mainframe protocols. This library also includes a family of operating systems with compilers, assemblers, and general utility programs. In 1983, Data General's Ada compiler became the first compiler from a computer company to be validated by the Department of Defense (DOD).

Data General's operating systems provide compatibility throughout the Company's product families. In addition to its own operating systems, the Company also offers industry-standard operating systems, allowing Data General customers access to applications software developed by other firms. Data General also offers applications software packages, including Comprehensive Electronic Office (CEO) integrated office software, general accounting software, and manufacturing requirements planning software. Computer programs are furnished under nonexclusive licenses that permit use of the programs with equipment designated in the licenses. In addition, the Independent Software Vendor Program, introduced in 1982, provides application-specific software to customers through third-party vendors. There are currently more than 50 participating firms offering more than 100 various applications.

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Digital Equipment Corporation

Digital Equipment Corporation
146 Main Street
Maynard, Massachusetts 01754
Telephone: (617) 897-5111 Telex: 948457
(Millions of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF JULY 2

	1979	1980	1981	1982	1983	CAGR 1979-83
BALANCE SHEET DATA						
Working Capital	$1,076.9	$1,658.2	$2,029.8	$2,181.2	$2,377.0	21.9%
Long-Term Debt	$ 340.7	$ 489.7	$ 88.4	$ 92.4	$ 92.8	(27.8%)
Shareholders' Equity	$1,120.2	$1,651.7	$2,679.7	$3,164.5	$3,546.3	33.4%
After-Tax Return on Average Equity	17.6%	18.0%	15.9%	14.0%	8.5%	(16.6%)
OPERATING PERFORMANCE						
Revenue	$1,804.1	$2,368.0	$3,198.1	$3,880.8	$4,271.9	24.0%
United States	$1,148.7	$1,439.7	$1,945.7	$2,497.6	$2,734.1	24.2%
Non-United States	$ 655.4	$ 928.3	$1,252.4	$1,383.2	$1,537.8	23.8%
Expenses	$1,520.7	$1,985.2	$2,662.1	$3,296.0	$3,909.0	26.6%
Cost of Revenue	$1,012,3	$1,319.9	$1,778.7	$2,187.6	$2,606.0	26.7%
R&D Expense	$ 138.3	$ 186.4	$ 251.2	$ 349.8	$ 472.4	35.9%
SG&A Expense	$ 370.1	$ 478.9	$ 632.2	$ 758.6	$ 830.6	22.4%
Operating Income	$ 283.4	$ 382.8	$ 536.0	$ 584.8	$ 362.9	6.4%
Interest Expense	$ 24.3	$ 27.0	$ 29.2	$ 14.8	$ 13.1	(14.3%)
Interest Income	$ 35.8	$ 53.8	$ 60.6	$ 102.8	$ 61.2	14.3%
Income Before Tax	$ 294.9	$ 409.6	$ 567.4	$ 672.8	$ 411.0	8.7%
NOTE: Pretax Margin	16.3%	17.3%	17.7%	17.3%	9.6%	(12.4%)
Taxes	$ 116.5	$ 159.7	$ 224.1	$ 255.6	$ 127.4	2.3%
Net Income After Tax	$ 178.4	$ 249.9	$ 343.3	$ 417.2	$ 283.6	12.3%
NOTE: Effective Tax Rate	39.5%	39.0%	39.5%	38.0%	31.0%	26.1%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	44.9	47.2	52.6	55.4	56.7	6.0%
Per Share Data						
Earnings	$ 4.10	$ 5.45	$ 6.70	$ 7.53	$ 5.00	5.1%
Dividends	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	N/M
Book Value*	$ 27.59	$ 36.25	$ 49.35	$ 57.12	$ 62.54	22.7%
Price Range (Low)	44 5/8-	52 3/4-	67-	65 3/4-	61 3/4-	N/M
(High)	58 1/5	82 1/2	113 1/4	102 1/2	130 1/8	
TOTAL EMPLOYEES	44,000	55,500	63,000	67,100	73,000	13.5%

N/M = Not Meaningful

* Calculated using shares outstanding of 40.6 million in 1979; 45.6 million in 1980; 54.3 million in 1981; 55.2 million in 1982; and 56.4 million in 1983.

Source: Digital Equipment Corporation Annual Reports & Forms 10-K, DATAQUEST

Digital Equipment Corporation
146 Main Street
Maynard, Massachusetts 01754
Telephone: (617) 897-5111 Telex: 948457

LINE ITEMS AS A PERCENT OF REVENUE

	1979	1980	1981	1982	1983
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	63.7%	60.8%	60.8%	64.4%	64.0%
Non-United States	36.3%	39.2%	39.2%	35.6%	36.0%
Expenses	84.3%	83.8%	83.2%	84.9%	91.5%
Cost of Revenue	56.1%	55.7%	55.6%	56.4%	61.0%
R&D Expense	7.7%	7.9%	7.9%	9.0%	11.1%
SG&A Expense	20.5%	20.2%	19.8%	19.5%	19.4%
Operating Income	15.7%	16.2%	16.8%	15.1%	8.5%
Interest Expense	1.3%	1.1%	0.9%	0.4%	0.3%
Interest Income	2.0%	2.3%	1.9%	2.6%	1.4%
Income Before Tax	16.3%	17.3%	17.7%	17.3%	9.6%
Taxes	6.5%	6.7%	7.0%	6.6%	3.0%
Net Income After Tax	9.9%	10.6%	10.7%	10.8%	6.6%
REVENUE PER EMPLOYEE	$0.04	$0.04	$0.05	$0.06	$0.06

Source: DATAQUEST

Digital Equipment Corporation

THE COMPANY

Background

Digital Equipment Corporation was founded in 1957 in Massachusetts. The Company designs, manufactures, sells, and services computers and associated peripheral equipment, and related software and supplies. The Company's products are used worldwide in a variety of applications and programs, including scientific research, computation, communications, education, data analysis, industrial control, time-sharing, commercial data processing, graphic arts, word processing, office automation, health care, instrumentation, engineering, and simulation.

Highlights--CAD/CAM Business

In April 1984, Digital Equipment introduced the VAX 11/785 processer, two relational DBMS software packages, and a videotex product.

The new CPU intensifies the competition between Digital and IBM, placing the VAX 11/785 in direct competition with the IBM 4361, as well as with Data General's Eclipse MV10000, and Prime's 9950.

In May 1984, Digital Equipment announced the formation of the Business Computer Group which will be responsible for all Digital computers sold through indirect channels to small businesses with annual sales less than $100 million.

Digital's VAX family of computers continues to sell well in the CAD/CAM environment and the company's third-party software agreements with major CAD software vendors continue to foster sales of the VAX line. DATAQUEST believes that Digital is well positioned in the CAD/CAM market; however, increased competition from Apollo, Sun Microsystems, Data General, and IBM, coupled with delay of the "Venus" high-end VAX system and a standalone workstation, is hampering Digital's effectiveness in further penetration and expansion in the engineering marketplace. DATAQUEST estimated Digital's 1983 CAD/CAM revenue, excluding sales through OEMs, to be $60 million.

Operations

Digital conducts operations in the United States and 43 other countries. Total operating revenue was $4,271.9 million in fiscal 1983. Revenue from equipment and from service and other revénues equaled 67.1 percent and 32.9 percent, respectively, of total revenue.

International Operations

Non-U.S. revenue equaled approximately 35 percent of total revenue in fiscal 1983. Sales and marketing operations outside of the United States are conducted primarily through sales subsidiaries in Canada, Europe, Central and South America, and the Far East; by direct sales from the parent corporation; or through representative and distributorship arrangements. International manufacturing operations are located in Canada, the Far East, and Western Europe.

Marketing

Digital markets its products through approximately 200 sales offices located throughout the world, primarily through a direct sales force. In addition to the 200 sales offices, Digital also operates approximately 350 additional outlets for its products and services comprising distributor offices, business center stores, remote service points, and field service-only centers. Digital employed approximately 81,500 individuals worldwide as of June 25, 1984.

Digital provides field engineering and maintenance support for all of its computer systems. Field engineering offers maintenance services in the form of a term contract or on a per call basis. Digital also offers various training programs for its computers and software systems. Training is generally conducted at Digital's training centers throughout the world.

Hardware Products

Digital offers a broad range of computer products. It sells small microprocessors such as the MICRO/T-11; a series of personal computers; a variety of minicomputers based on 12-bit (PDP-8), 16-bit (PDP-11), and 32-bit (VAX) architecture; and large mainframe computers (DECsystem-10, DECsystem-20).

The models included in the PDP-8, PDP-11, and VAX families are general-purpose digital computers designed for performing, interpreting, and recording computations on collected data. Members of the PDP-11 family range from the MICRO/T-11, a low-cost OEM-oriented microprocessor, to the PDP-11/44, a mid-range system. The VAX family of computers currently includes seven models: the MicroVAX-I, -II, the VAX-11/730, -11/750, -11/780, -11/782, and -11/785. The DECsystem-10 and DECsystem-20 are the largest computer systems manufactured by Digital. These systems are designed for multiuser access, batch processing, and real-time applications.

Digital also manufactures and sells computer peripheral devices that include magnetic tape transports, tape cassette and disk storage devices, cathode ray tube display systems, analog-to-digital converters, perforated tape readers, tape punches, terminals, and line printers. Additionally, Digital buys selected peripheral equipment from other manufacturers for use with its own computer systems.

Software Products

Digital designs and sells under license various software products for its computer systems. These products consist of operating systems, languages, data handling services, communications software, special applications software, and utility software. In addition, Digital has extensive third-party software marketing agreements for CAD/CAM and other applications software.

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Evans and Sutherland
Computer Corporation

Evans & Sutherland Computer Corporation

Evans & Sutherland Computer Corporation
580 Arapeen Drive
Salt Lake City, Utah 84108
Telephone: (801) 582-5847
(Millions of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF DECEMBER 31

	1979	1980	1981	1982	1983	CAGR 1979-83
BALANCE SHEET DATA						
Working Capital	$ 9.5	$ 24.6	$ 32.8	$ 40.9	$ 60.6	58.9%
Long-Term Debt	$ 0.0	$ 1.2	$ 1.4	$ 1.6	$ 1.4	4.8%
Shareholders' Equity	$ 11.6	$ 28.9	$ 38.9	$ 49.5	$ 62.0	52.2%
After-Tax Return on Average Equity	22.3%	41.5%	39.7%	28.8%	24.8%	2.7%
OPERATING PERFORMANCE						
Revenue	$ 20.0	$ 34.7	$ 46.4	$ 53.7	$ 60.6	31.9%
U.S. Revenue	$ 14.6	$ 25.0	$ 35.6	$ 43.4	$ 52.0	37.3%
Non-U.S. Revenue	$ 5.4	$ 9.7	$ 10.9	$ 10.3	$ 8.6	12.5%
Expenses	$ 16.0	$ 24.8	$ 31.3	$ 39.0	$ 44.3	28.9%
Cost of Revenue	$ 12.3	$ 18.1	$ 20.8	$ 26.4	$ 28.2	23.0%
R&D Expense	$ 1.0	$ 2.1	$ 3.9	$ 5.1	$ 6.7	60.9%
SG&A Expense	$ 2.7	$ 4.6	$ 6.6	$ 7.5	$ 9.4	36.6%
Other Expense	0	0	0	0	0	
Operating Income	$ 4.0	$ 9.9	$ 15.1	$ 14.8	$ 16.3	42.2%
Interest Expense	0	0	0	0	0	
Interest Income	0	0	0	0	0	
Other Income (Expense)	0	0	0	0	0	
Income before Tax	$ 4.5	$ 10.8	$ 17.2	$ 16.9	$ 18.5	42.3%
NOTE: Pretax Margin	22.6%	31.1%	37.0%	31.5%	30.6%	7.8%
Taxes	$ 2.2	$ 4.8	$ 9.4	$ 9.8	$ 10.8	4.6%
NOTE: Effective Tax Rate	48.9%	44.3%	55.0%	57.9%	58.5%	N/M
Net Income after Tax	$ 2.3	$ 6.0	$ 7.7	$ 7.1	$ 7.7	35.1%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	2.2	8.3	8.6	8.8	8.8	41.4%
Per Share Data						
Earnings	$ 0.32	$ 0.76	$ 1.07	$ 1.10	$ 1.21	39.4%
Dividends	0	0	0	0	0	
Book Value	$ 5.25	$ 3.48	$ 4.52	$ 5.65	$ 7.05	7.6%
Price Range (Low)	$12-3/8	$ 5-3/4	$ 18	$18-1/4	$ 28	N/M
(High)	$ 21	$27-1/2	$ 39	$ 48	$50-1/4	N/M
TOTAL EMPLOYEES	450	520	625	775	850	17.2%

N/M = Not Meaningful

Source: Evans & Sutherland Computer Corporation
Annual Reports & Forms 10K
DATAQUEST

Evans & Sutherland Computer Corporation
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(Millions of Dollars Except Per Share Data)

LINE ITEMS AS A PERCENT OF REVENUE

	1979	1980	1981	1982	1983
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	73.1%	72.0%	76.6%	80.8%	85.8%
Non-United States	26.9%	28.0%	23.4%	19.2%	14.2%
Expenses	80.1%	71.5%	67.4%	72.5%	73.1%
Cost of Revenue	61.7%	52.1%	44.8%	49.0%	46.6%
R&D Expense	5.0%	6.0%	8.4%	9.5%	11.1%
SG&A Expense	13.4%	13.4%	14.3%	14.0%	15.5%
Other Expense	0	0	0	0	0
Operating Income	19.9%	28.5%	32.6%	27.5%	26.9%
Interest Expense	0	0	0	0	0
Interest Income	0	0	0	0	0
Other Income (Expense)	0	0	0	0	0
Income before Tax	22.6%	31.1%	37.0%	31.5%	30.6%
Taxes	11.0%	13.8%	20.3%	18.3%	17.9%
Net Income after Tax	11.5%	17.3%	16.6%	13.3%	12.7%

Source: DATAQUEST

Evans & Sutherland Computer Corporation

THE COMPANY

Background

Evans and Sutherland Computer Corporation (E&S) designs, manufactures, markets, and services special-purpose digital components, graphics terminals, and software systems. The Company's products include high-performance, interactive graphics systems used in design engineering, scientific research, graphic arts applications, and sophisticated visual displays for pilot training simulators. The Company was founded in 1968, in Salt Lake City, Utah, by David C. Evans, Chairman of the Board, and Ivan E. Sutherland. Mr. Sutherland's "Sketchpad," done at the Massachusetts Institute of Technology's Lincoln Laboratory approximately 22 years ago, contributed significantly to the early development and evolution of the CAD/CAM industry.

Highlights

Early in 1984, Evans and Sutherland invested in Unicad, Inc., a new company located in Boulder, Colorado. E&S now owns a majority of the shares of Unicad. Unicad was founded to develop and market a set of commercial CAD/CAM development tools that allow OEMs and users to create their own applications. These tools will reduce programmer training problems involved in the introduction of new systems and include a general-purpose data base management package. The Unicad product will utilize Romulus Solid Geometric Modeling.

In the face of the IBM 5080 announcement and increasing competition from other high-performance graphics vendors, E&S announced an across the board price reduction of its PS300 line of graphics systems in February 1984. According to Company officials, the reduction was aided by decreasing costs in custom VLSI circuits and by economies of scale achieved through volume manufacturing of graphics terminals.

Operations

The University of Utah Research Park in Salt Lake City, Utah, houses all E&S executive offices, manufacturing, and research facilities. These facilities occupy approximately 260,000 square feet of space. The company now employs approximately 850 people, with a large percentage of them engaged in engineering activities.

International Operations

E&S's acquisition of Shape Data, Ltd., of Cambridge, England, in December 1981, continues to provide a significant foothold for the Company in the non-U.S. marketplace.

Marketing and Sales

Evans and Sutherland generally sells its hardware and licenses the related software (e.g., Romulus). The Company's Interactive Systems Group is responsible for marketing and sales of the interactive graphics products to the sophisticated end-user marketplace. Company sales address three markets, which E&S characterizes as follows:

- CAD/CAM and interactive graphics
- Pilot training for airlines and general aviation
- Military tactical training

The Company operates nine sales offices, which are located in the following cities:

- Atlanta, Georgia
- Birmingham, Michigan
- Cincinnati, Ohio
- Chicago, Illinois
- Dallas, Texas
- Framingham, Massachusetts
- Houston, Texas
- McLean, Virginia
- St. Louis, Missouri

Non-U.S. sales are made by a combination of wholly owned subsidiaries and representatives located in the following countries: Australia, England, France, Germany, Taiwan, and Tokyo.

Non-U.S. revenues traditionally have accounted for 20 to 25 percent of the Company's revenues. During the past 12 to 18 months, however, this percentage has declined to approximately 15 percent of total revenues.

Research and Development

During the past three years, Shape Data of Cambridge, England, has provided the technical base for most of the Company's research and product development for mechanical computer-aided engineering, design, and manufacturing applications. Shape Data was one of the original pioneers of "solid modeling" technology.

Table 1 indicates Evans & Sutherland's Research and Development expenditures through fiscal year 1983, which ended December 30.

E&S continues to direct its efforts toward advancements in both hardware and software design through a separate CAD/CAM research group within the Company, which was established during 1983.

Table 1

Evans & Sutherland
RESEARCH AND DEVELOPMENT EXPENSES

	1980	1981	1982	1983
R&D Expense ($K)	$2,079	$3,883	$5,128	$6,706
Percent of Revenue	6.0%	8.4%	9.5%	11.1%
R&D Expenses Per Employee	$3,998	$6,212	$6,617	$7,889

Source: Evans & Sutherland Computer Corporation 1983 Annual Report

Manufacturing

E&S's major manufacturing and OEM source relationships are as follows:

- February 1984--E&S invested in Unicad, Inc., a Boulder, Colorado, company. E&S obtained a majority interest in Unicad and access to additional software technologies.

- December 1983--By year-end, E&S held a small interest in Mosaic Systems, a company involved in developing techniques used in wafer-scale integration. This wafer-scale integration technique will be integrated into the simulation product line, some time during late 1984.

- December 1982--E&S invested in VLSI Technology, Inc. (VTI), a company engaged in electronics manufacturing. This investment gives E&S certain rights to VTI's production capacity and manufacturing technology, and nonexclusive use of its design tools.

- December 1981--E&S acquired Shape Data Ltd., of Cambridge, England. E&S acquired software development capabilities and a presence in the non-U.S. CAD/CAM marketplace.

MAJOR HISTORICAL MILESTONES

Other significant milestones since E&S's entry into the computer graphics marketplace are listed below:

- June 1983--Announced three new members of the PS300 family of computer graphics systems and new system interfaces. The new system introductions are outlined in the Products section of this company profile.

- December 1982--Announced the PS300/Romulus package, a combination of new hardware/software, respectively. E&S also introduced the calligraphic shadow mask color display for the PS300 graphics system, providing for real-time dynamic design and analysis.

- June 1981--Announced the PS300 distributed graphics system, the first in a family of interactive graphics systems offered by E&S.

CAD/CAM PRODUCTS

Evans and Sutherland was a pioneer in the development of high-performance computer graphics and continues to be a major supplier of interactive graphics workstations. The products currently offered by E&S are featured in Table 2.

Table 2

Evans & Sutherland
CURRENT PRODUCTS

SYSTEMS

Name	Manufacturer	Word Size	Number of Workstations
VAX-Based	Digital Equipment	32-Bit*	Dictated by host computer type and application
IBM-Based	IBM	32-Bit	

WORKSTATIONS

Name	Type	Resolution	Screen Size	Number of Colors
PS-320	Host-Dependent	8,192 x 8,192** Addressable Locations	19 inch	1
PS-330	Host-Dependent	8,192 x 8,192 Addressable Locations	19 inch	1-1,800
PS-340	Host-Dependent	8,192 x 8,192 Addressable Locations	19 inch	1-1,800

BASE SOFTWARE

Name	Mechanical	AEC	PC	IC	EDA	Mapping
Romulus	X					

APPLICATIONS SOFTWARE

Available only from third-party software vendors

*Digital Equipment's VAX 11/780 is predominantly used as the host system for E&S workstations
**Except when a raster option (available through E&S) is used, thereby providing a resolution of 640 x 480 x 24

Source: Evans & Sutherland Computer Corporation

OTHER BUSINESS

In addition to its interactive graphics products, Evans and Sutherland is a leading supplier of Computer Image Generation (CIG) visual systems used for operator training and engineering simulation. An E&S CIG system provides a user with high-quality real-time, out-of-the-window scenes based upon a three-dimensional digital model of the environment. Sales of CIG Visual Systems accounted for two-thirds of the Company's revenues in 1983. E&S serves this marketplace through a collaborative arrangement with Rediffusion Simulators, Inc., a leading supplier of simulation equipment worldwide, and through two business groups within the company.

E&S serves the Visual Systems marketplace with the following product families:

- Novoview Family
  - SP1--The most widely used visual system in the world, it is certified for FAA Phase II training of commercial airline pilots.
  - SP3--The SP3 provides full daylight training capability and is the world's first simulation system to meet the stringent FAA Phase III requirements.
- CT5 Family
  - The CT5 was jointly developed by E&S and Rediffusion Simulators, Inc.
  - It is a high-performance raster-scan visual simulator designed to meet military flight training requirements.

E&S continues its heavy investment in the development of its visual systems products. For instance, during 1983 major performance enhancements in the CT5 were introduced to further exploit the potential of this system. The average price of a CT5 is $5 million.

Gould, Incorporated

Gould Inc.

Gould Inc.
10 Gould Center
Rolling Meadows, IL 60068
Telephone: (312) 640-4000 Telex: 28-2473
(Millions of Dollars Except Per Share Data)

Balance Sheet (December 31)

	1979	1980	1981	1982	1983
Working Capital	$ 521.7	$ 615.5	$ 495.6	$ 508.3	$ 366.5
Long-Term Debt	$ 470.0	$ 368.0	$ 345.8	$ 299.2	$ 229.6
Shareholders' Equity	$ 770.8	$ 801.9	$ 809.6	$ 887.5	$ 885.1
After-Tax Return on Average Equity (%)	14.7	9.4	11.9	10.9	7.2

Operating Performance (Fiscal Year Ending December 31)

	1979	1980	1981	1982	1983
Revenue	$1,527.3	$1,611.7	$1,846.1	$1,252.8	$1,324.8
U.S. Revenue	$1,437.3	$1,497.1	$1,687.4	$1,067.1	$1,137.4
Non-U.S. Revenue	$ 90.0	$ 114.6	$ 158.7	$ 185.7	$ 187.4
Cost of Revenue	$1,081.1	$1,147.3	$1,239.3	$ 741.7	$ 793.0
R&D Expense	$ 78.0	$ 100.3	$ 118.9	$ 102.0	$ 111.4
SG&A Expense	$ 275.2	$ 307.9	$ 380.7	$ 314.1	$ 330.3
Pretax Income	$ 124.5	$ 93.4	$ 127.4	$ 120.9	$ 117.4
Pretax Margin (%)	8.0	5.7	6.8	9.6	8.9
Effective Tax Rate (%)	35.3	36.6	32.2	33.9	32.6
Net Income	$ 108.3	$ 74.1	$ 95.7	$ 92.8	$ 64.1
Average Shares Outstanding (Millions)	33.511	34,271	35,627	43,540	44,705
Per Share					
Earnings	$ 3.21	$ 2.15	$ 2.68	$ 2.15	$ 1.42
Dividends	$ 1.66	$ 1.72	$ 1.72	$ 1.72	$ 1.72
Book Value	$ 22.68	$ 23.10	$ 22.94	$ 20.34	$ 19.80
Price Range	$ 22 1/4-29 7/8	$ 19 1/4-29	$ 21 5/8-30 7/8	$ 19 3/4-39 1/2	$ 25 3/4-43 3/4
Total Employees	26,689	27,129	28,776	19,976	20,651

N/A = Not Available

Source: Gould Incorporated
Annual Reports & Forms 10-K
DATAQUEST

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Gould Inc.

THE COMPANY

Background

Gould Inc. develops, manufactures, and markets electronic systems, products, and components. The Company was incorporated in 1928 in Delaware as Gould Storage Battery. National Battery of St. Paul, Minnesota, purchased the Company in 1930, and the company name was later changed to Gould National Batteries. In 1969, the company name was changed to Gould Incorporated. During the 1960s and 1970s, Gould expanded by acquiring more than 50 companies.

In the late 1970s, Gould redefined its business base into high-growth electronics, and began investing in closely related electronics markets and divesting itself of its non-electronic-related businesses.

Highlights--CAD/CAM Business

In March 1984, Gould introduced four new minicomputer product lines:

- CONCEPT 32/97--Gould's most powerful 32-bit minicomputer. In its basic configuration, the system includes a single CPU, 4 Mbytes main memory, and 32 Kbytes cache memory.

- PowerNode 6000--A 32-bit UNIX-based virtual processor that comes in three models.

- PowerStation 3100 and 5100--Standalone workstations for mechanical CAD/CAM applications. Both of the new workstations are UNIX-based, and use a mechanical CAD/CAM package acquired by Gould from Vulcan Software under a software license agreement. Except for performance and expansion capability, both systems provide the same functionality and use the same software.

With the incorporation of Vulcan's mechanical CAD/CAM software in the PowerStation 3100 and 5100, Gould officially entered the CAD/CAM marketplace as a turnkey supplier. DATAQUEST believes that Gould's core business resources and technology, coupled with its extensive presence as an OEM supplier to the engineering, scientific, and industrial applications markets, positions Gould as a viable competitor in the CAD/CAM/CIM marketplace.

Gould Inc.

Operations

Gould is composed of four business sections serving six markets. Electronic Systems serves the markets for 32-bit minicomputers and factory automation; Electronic Products serves the test and measurement and medical instrumentation markets; Electronic Components serves the market for electronic components and materials; and Defense Systems operates in the defense market. Each business section is headed by an executive vice president and an operating board composed of Gould managers and outside technology experts in related fields. Gould electronics sales in 1983 were $1.32 billion.

Operations are conducted by Gould in 17 states in 57 plants, and in 10 foreign countries in 15 plants. Gould employed 20,547 individuals as of January 31, 1984.

International Operations

Gould conducts operations outside the United States in 15 plants located in Canada, France, Ireland, Korea, Mexico, the Netherlands, Norway, the Philippines, the United Kingdom, and West Germany.

Marketing

Gould sells its test and measurement and medical instrumentation products, as well as its MOS/VLSI semiconductors and certain other components, both directly and through distributors. All of the Company's other electronic systems, products, and materials are sold through a direct sales force.

Research and Development

Gould Research Center in Rolling Meadows, Illinois, is the central research and development arm for Gould Inc. Laboratory research focuses on computer science and software, signal processing, and electronic devices and materials. Gould's research and development expenditures in 1983 totaled $155 million (including externally funded research), or 11.7 percent of revenue.

CAD/CAM BUSINESS

Gould's CAD/CAM business operation is part of the Computer Systems Division, Fort Lauderdale, Florida.

Gould Inc.

The Computer Systems Division manufactures 16/32 superminicomputers and high-performance 32-bit minicomputers. These are used in real-time scientific and industrial applications such as factory automation, aircraft simulation, computer-aided design, and seismic data reduction. To accelerate market penetration, Gould is pursuing third-party software agreements for CAD/CAM applications software.

Products

The CONCEPT 32 Series is a family of 32-bit minicomputer systems consisting of four product lines: CONCEPT 32/27, CONCEPT 32/67, CONCEPT 32/87, and CONCEPT 32/97. Each product line has three members, affording a wide range of price/performance options for OEMs and end users.

The PowerSeries is a distributed systems family of micro- and minicomputer-based intelligent workstations, specifically designed for computer-aided-engineering/computer-integrated-manufacturing (CAE/CIM) applications.

The PowerDesign workstation family uses 16/32-bit supermicrocomputers and 32-bit superminicomputers. Software for the PowerDesign workstation provides integrated functionality for drafting, design, and solids modeling, as well as for numerical control applications. The PowerDesign workstations support optional translators for Applicon, Computervision, Calma, and Intergraph.

The PowerNode computer systems are optional back-end processors that provide computational capabilities for finite element analysis and high-speed solids modeling. PowerNodes can be linked to the PowerDesign workstations through Ethernet.

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Hewlett-Packard

Hewlett-Packard Company

Hewlett-Packard Company
1501 Page Mill Road
Palo Alto, California 94304
Telephone: (415) 857-1501

Corporate Financial Profile as of October 31

BALANCE SHEET DATA

	1982	1983	1984	1985	1986	CAGR 1982-1986
Working Capital	$1,352.0	$1,712.0	$1,879.0	$1,966.0	$2,296.0	23.8%
Long-Term Debt	$ 39.0	$ 71.0	$ 81.0	$ 102.0	$ 110.0	29.3%
Shareholders' Equity	$2,349.0	$2,887.0	$3,545.0	$3,982.0	$4,374.0	23.0%
After-Tax Return on Average Equity (%)	17.9%	16.5%	17.0%	13.0%	12.4%	

OPERATING PERFORMANCE

	1982	1983	1984	1985	1986	CAGR 1982-1986
Revenue	$4,880.0	$4,922.0	$6,350.0	$6,505.0	$7,102.0	9.8%
U.S. Revenue	$2,983.0	$2,901.0	$3,629.0	$3,696.0	$3,812.0	6.3%
Non-U.S. Revenue	$1,897.0	$2,021.0	$2,721.0	$2,809.0	$3,290.0	14.8%
Cost of Goods Sold	$1,967.0	$2,195.0	$2,865.0	$2,423.0	$2,479.0	6.0%
Gross Margin	$2,913.0	$2,727.0	$3,485.0	$4,082.0	$4,623.0	12.2%
Expenses	$2,237.0	$1,999.0	$2,625.0	$3,324.0	$3,843.0	14.5%
R&D Expense	$ 424.0	$ 493.0	$ 592.0	$ 685.0	$ 824.0	18.1%
SG&A Expense	$1,122.0	$1,294.0	$1,727.0	$1,896.0	$2,145.0	17.6%
Net Other Expense	$ 691.0	$ 212.0	$ 306.0	$ 743.0	$ 874.0	6.0%
Operating Income	$ 676.0	$ 728.0	$ 860.0	$ 758.0	$ 780.0	3.6%
Interest Income (Expense)	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0	N/A
Other Income (Expense)	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0	N/M
Income before Tax	$ 676.0	$ 728.0	$ 860.0	$ 758.0	$ 780.0	3.6%
NOTE: Pretax Margin	13.9%	14.8%	13.5%	11.7%	11.0%	
Taxes	$ 293.0	$ 296.0	$ 313.0	$ 269.0	$ 264.0	(2.6%)
NOTE: Effective Tax Rate	43.3%	40.7%	36.4%	35.5%	33.8%	
Net Income after Tax	$ 383.0	$ 432.0	$ 547.0	$ 489.0	$ 516.0	7.7%

SHAREHOLDER DATA

	1982	1983	1984	1985	1986	CAGR 1982-1986
Average Shares Outstanding (Millions)	125.0	255.0	256.0	256.9	256.9	19.7%
Per Share Data						
Earnings	$ 1.53	$ 1.69	$ 2.59	$ 1.91	$ 2.02	7.2%
Dividends	$ 0.12	$ 0.16	$ 0.19	$ 0.22	$ 0.22	16.4%
Book Value	$ 18.79	$ 11.32	$ 13.85	$ 15.50	$ 17.03	(2.4%)
Price Range (Low)	36 3/8	32	31 5/8	28 3/4	30	
(High)	65 3/8	48	45	38 3/4	49 1/8	
TOTAL EMPLOYEES	68,000	72,000	82,000	84,000	82,000	4.8%
Revenue per Employee	$ 71,765	$ 68,361	$ 77,439	$ 77,440	$ 86,610	4.8%

(Continued)

Hewlett-Packard Company (Continued)
1501 Page Mill Road
Palo Alto, California 94304
Telephone: (415) 857-1501

Corporate Financial Profile as of October 31

	1982	1983	1984	1985	1986	CAGR 1982-1986
OPERATING PERFORMANCE						
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%
United States	61.1%	58.9%	57.1%	56.8%	53.7%	(3.2%)
Non-United States	38.9%	41.1%	42.9%	43.2%	46.3%	4.5%
Cost of Goods Sold	40.3%	44.6%	45.1%	37.2%	34.9%	(3.5%)
Gross Margin	59.7%	55.4%	54.9%	62.8%	65.1%	2.2%
Expenses	45.8%	40.6%	41.3%	51.1%	54.1%	4.2%
R&D Expense	8.7%	10.0%	9.3%	10.5%	11.6%	7.5%
SG&A Expense	23.0%	26.3%	27.2%	29.1%	30.2%	7.1%
Other Expense	14.2%	4.3%	4.8%	11.4%	12.3%	(3.4%)
Operating Income	13.9%	14.8%	13.5%	11.7%	11.0%	(5.6%)
Interest Income (Expense)	0.0%	0.0%	0.0%	0.0%	0.0%	N/M
Other Income (Expense)	0.0%	0.0%	0.0%	0.0%	0.0%	N/M
Income before Tax	13.9%	14.8%	13.5%	11.7%	11.0%	(5.6%)
Taxes	6.0%	6.0%	4.9%	4.1%	3.7%	(11.3%)
Net Income after Tax	7.8%	8.8%	8.6%	7.5%	7.3%	(1.9%)

N/M = Not Meaningful

Source: Hewlett-Packard Company
Dataquest
December 1987

THE COMPANY

Hewlett-Packard Company (HP) was incorporated in 1947 in California as the successor to a partnership founded in 1939 by William R. Hewlett and David Packard. HP entered the CAD/CAM market in 1984.

The Company is engaged worldwide in the design, manufacture, marketing, and servicing of computers and precision electronic instruments and systems for measurement and analysis. HP products are used in industry, business, engineering, science, education, and medicine. HP's CAD/CAM business is the focus of this profile.

Positioning

HP sells and supports turnkey CAD systems, and derives 1.9 percent of its revenue from CAD/CAM markets. The Company's performance and market share history is shown in Tables 1 and 2. HP ranks third in the worldwide technical workstation market for CAD applications, for both 1986 shipments and revenue.

Table 1

Hewlett-Packard
CAD/CAM Performance
(Millions of Dollars and Actual Units)

	1985	1986
Revenue	$ 90	$ 132
Workstation Shipments	1,447	2,865
Workstation Installed	1,447	4,312

Source: Dataquest
December 1987

Table 2

Hewlett-Packard
CAD/CAM Market Share History
(Percent of Segment)

	1985	1986	1986 Rank in Market
All Applications			
Revenue	2%	2%	11
Workstation Shipments	1%	2%	6
Mechanical			
Revenue	2%	2%	10
Workstation Shipments	2%	2%	4
Facilities Design			
Revenue	1%	1%	15
Workstation Shipments	1%	1%	12
Electronic CAE			
Revenue	0%	1%	15
Workstation Shipments	0%	1%	10
PCB Layout			
Revenue	6%	5%	7
Workstation Shipments	8%	6%	2

Source: Dataquest
December 1987

Financial

Revenue for the third quarter, which ended July 31, 1987, was $5.8 billion, with net earnings of $426 million. U.S. revenue during this period was $3.0 billion.

HIGHLIGHTS

Listed below in reverse chronological order are recent company highlights:

- June 1987—The Company announced a test-program generator that links the HP Electronic Design System with the HP 3065 family of PCB test systems.

- June 1987—HP introduced Teamwork/Access, an interface to the Company's documentation, project management, and software development tools.

- May 1987—HP introduced new models in the 9000 Series 800 Precision Architecture computers.
- May 1987—Weitek and HP announced a product and manufacturing exchange, whereby HP will manufacture the Weitek 2264/65 floating-point processor, and also will incorporate the chip set into current and future HP Precision Architecture computers.
- November 1986—The 9000 Series Model 840 Precision Architecture computer began shipping. Model 840, designed for technical applications, is the first HP computer based on RISC architecture, and is compatible with the rest of the 9000 Series product line.

ORGANIZATION

HP's CAD products fall under the Company's Technical Systems Sector (TSS). Within TSS, the Technical Computer Group manages computer hardware. The Engineering and Manufacturing Systems Group manages all software, including HP application software, third-party application software, and HP system software.

Personnel Distribution

The Company's 84,000 personnel, 56,000 of whom are in the United States, are distributed as follows:

Department	Percentage of Employees
R&D/Engineering	15%
Marketing	8
Sales	20
Field Support	8
Administration	13
Other	36
Total	100%

CAD/CAM Operations

The Company's CAD/CAM operations are listed below:

Location	Purpose/Charter
Fort Collins, CO	CAD/CAE operations and workstations; third- party application software
Colorado Springs, CO	Electronic CAE software, layout interfaces, microprocessor development systems
Salt Lake City, UT	Software development and AI research (former Cericor operation)
Lake Stevens, WA, and Boblingen, W. Germany	Mechanical software development

MARKETING AND SALES

Strategy

HP, the quintessential engineering company, is well positioned to sell engineering design automation products to users of its other products. Although HP is a relatively late entrant to the CAD/CAM market, the Company's steep growth curve places it eleventh in the 1986 worldwide CAD market. Most of HP's CAD sales have been turnkey systems based on HP software.

As a computer manufacturer, HP also wants to sell computer hardware to both end users and resellers for CAD applications. Toward that end, HP maintains a substantial catalog of third-party CAD software suppliers. Through its Software Evaluation and Migration Center, HP has also succeeded in helping more than 100 vendors port 150 software packages to its RISC-based computers.

HP is adopting a mixed strategy that might be characterized as both flexible and cautious. On one hand, the Company is trying to position its computers as a standard CAD hardware alternative, complete with third-party alliances and applications. On the other hand, HP can also claim end-to-end solutions, particularly differentiated by the ability to link electronic design data with HP mechanical design, software engineering, and PCB test products.

HP primarily sells its products to industries that use CAD heavily: aerospace/ military, automotive, machinery, computers, communications, government, and education. The Company also uses a substantial amount of its CAD/CAM products internally.

Distribution

HP sells its CAD/CAM products direct through 124 U.S. sales offices. Government sales, which were 9.5 percent of total 1986 company revenue, are through a dedicated federal sales force.

Company-wide, HP has 291 sales and service offices in 102 cities in the United States and in 38 non-United States countries. Most non-United States sales are direct through HP subsidiaries. In countries with low sales volumes, sales are made through various representative and distributorship arrangements. Company-wide, one-third of HP's 1986 equipment sales were through indirect channels.

SALES SUPPORT

Warranties and Maintenance Agreements

HP warrants its hardware for 90 days, its software for 30 days. The Company also offers hardware, software, or system maintenance plans, either on a monthly or on-call basis. Maintenance is provided by HP employees.

Training

Training is offered at several U.S. locations, and in most major non-United States countries. Typical training courses are one to three weeks long.

STRATEGIC ALLIANCES

Mergers and Acquisitions

In 1986, HP acquired Cericor, Incorporated, of Salt Lake City, Utah, and its electronic CAE product line.

OEM Agreements

The Company resells PCB software from Bell Northern, and electronic CAE software from Genrad (HiLo) and Analog Design Tools (Analog Workbench).

Joint Marketing Agreements

HP has joint marketing agreements with several ASIC and other IC foundries. The Company also has joint marketing agreements with a long list of third-party software suppliers.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- July 1986—The Company introduced electronic CAE products based on the former Cericor product line. Key features of the Cericor line are an object-oriented data base, and a strong user interface and application development environment.

- July 1986—HP introduced the Design System Manager, which provides design check-in and check-out, revision control, and network file management. In addition, the Company announced the Printed Circuit Design System.

- June 1986—HP announced HP Teamwork/Structured Analysis, software development tools designed as a companion product for the HP Microprocessor Development system.

- November 1985—The Company announced several new CAD workstations based on the 9000 Series computer:

  - The ME Series 10 2-D mechanical design and drafting workstation, and the ME Series 50 solid modeling workstation

  - The Logic DesignStation for schematic capture and verification

- November 1985—HP also announced that five electronic CAD/CAM vendors (Analog Design Tools, Futurenet, SDA, VLSI Technology, and Zuken,) had signed an agreement whereby HP would sell these software products, while the suppliers would provide pre- and postsales technical and application support.

- September 1985—HP announced the intended acquisition of Cericor, a Salt Lake City-based electronic CAE software company.

- April 1985—The Company introduced HP FE finite element analysis software.

- August 1984—The Company signed a cooperative marketing agreement with GenRad for its HiLo logic simulation software for the HP 9000 series computer.
- May 1984—HP announced that it had completed the purchase of a 10 percent equity interest in Manufacturing and Consulting Services, Inc., a mechanical CAE software supplier.

CAD/CAM PRODUCTS

The Company's products are summarized in Table 3. The pages following this table provide a detailed description of each product, with one product per page. These product pages are presented in the order in which they appear in Table 3.

Table 3

Hewlett-Packard Products

Technical Workstations

Model	Manufacturer	Resolution	Description
9000 Series, Models 318, 330, 350	Hewlett-Packard	1,024 X 768	All HP computers run on UNIX V.3 operating system
9000 Series, Models 350SRX, 825 SRX	Hewlett-Packard	1,280 X 1,024	3-D solid modeling systems

Host Systems

Model	Manufacturer	Number of Users	Description
9000 Series, Models 825S, 840S, 850S	Hewlett-Packard	128	Compatible with 9000 Series 300 workstations. Based on HP-PA RISC processor, which includes 48-bit and 64-bit virtual addressing

Application Software

Model	Platform	Segment	Description
Electronic Engineer, Design Capture	Technical workstation	Electronic CAE	Includes schematic capture with object-oriented data base and generic library. Runs on HP 9000, Series 300, Series 800
Electronic Engineer, Symbol Libraries	Technical workstation	Electronic CAE	Symbol libraries for design capture system
Electronic Engineer, Design Verification	Technical workstation	Electronic CAE	Logic simulation based on HiLo. Runs on 9000 series 320/330, 350, or 840

(Continued)

Table 3 (Continued)

Hewlett-Packard Products

Application Software

Model	Platform	Segment	Description
Electronic Engineer, Analog Workbench	Technical workstation	Electronic CAE	Includes schematic capture, circuit simulation. Options include device libraries, statistical analysis of a circuit's component tolerances, and graphic representation of the results
Electronic, Fault Simulation	Technical workstation	Electronic CAE	Fault simulation
Electronic Engineer, Interfaces	Technical workstation	PCB layout	Several electronic design interfaces to other products, including HP board testers, Calay, Computervision, Racal Redac, Scicards, physical modeler
Engineering Graphics System	Technical workstation	PCB layout	Manual layout. Runs on HP 9000, Series 300, Series 800
Electronic Engineer, Printed Circuit	Technical workstation	PCB layout	Includes autorouting, SMD, hybrids
Microprocessor Development	Technical workstation	Electronic CAE	Microprocessor development system for CASE applications. Runs on 9000 Series computer
HP Teamwork	Technical workstation	General-purpose	Provides structured documentation of software development. Used with Microprocessor Development system
Touchstone	Technical workstation, PC	Electronic CAE	Design of microwave products. Runs on HP Vectra PC or 9000 Series
Mechanical Engineer, Series 5	Technical workstation	Mechanical	Compatible with ME Series 10 and 30. Functions include 2-D, drafting, other design/analysis. Runs on HP 9000, Series 300, Series 800
Mechanical Engineer, Series 10	Technical workstation	Mechanical	Includes macro programming language for parametric design and design evaluation, links to NC, FEM/FEA, DXF, and APT and COMPACT II NC language output
Mechanical Engineer, Series 30	Technical workstation	Mechanical	Includes ME 5 and ME 10 functions, solid modeler; commands for creating solid models from 2-D geometry; and links to ANSYS, FEMGEN, and Patran. Can be used with HP SRX graphics

Other Software

Model	Platform	Type	Description
HP-UX	Technical workstation	Operating system	UNIX V.3-based operating system

Source: Dataquest
December 1987

CAD PRODUCT DESCRIPTION

Price: $4990

Model: 9000 Series, 318 M
Type: Technical Workstation System

Date of product introduction: 1/87

System Configuration:

Manufacturer: Hewlett-Packard
Operating System: Unix V.3
Communication Protocols: Ethernet, TCP/IP
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included.

No storage included. Expandable to 81 Mbyte at an increase of $4550

Workstation Configuration:

Manufacturer: Hewlett-Packard
1024 x 768 resolution. Monochrome

Comments:
No expansion slots. HP-IB and RS232 connectors available for storage and output devices

8710-1316-2204 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $12950

Model: 9000 Series, 330 MH
Type: Technical Workstation System

Date of product introduction: 1/87

System Configuration:

Manufacturer: Hewlett-Packard
Operating System: UNIX V.3
Communication Protocols: Ethernet, TCP/IP
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 8 Mbyte at an increase of $5450

No storage included. Expandable to 571 Mbyte at an increase of $17600

Workstation Configuration:

Manufacturer: Hewlett-Packard
1024 x 768 resolution. Monochrome
Upgrade description: $4,300 additional for 64 displayable colors

8710-1316-0614 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $25100

Model: 9000 Series, 350 CH
Type: Technical Workstation System

Date of product introduction: 1/87

System Configuration:

Manufacturer: Hewlett-Packard
Operating System: UNIX V.3
Communication Protocols: Ethernet, TCP/IP
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
8.0 Mbyte main memory included. Expandable to 48 Mbyte at an increase of $52000

No storage included. Expandable to 6850 Mbyte

Workstation Configuration:

Manufacturer: Hewlett-Packard
1280 x 1024 resolution. Monochrome
Upgrade description: $8,450 additional for 256 displayable colors

CAD Application Software:
two-dimensional

Comments:
Above base price does not include disk drive. Typical configuration has 307 MB. Drawing speed: 80,000 vectors/second

8710-1316-3002 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $56000

Model: 9000 Series, 350 SRX
Type: Technical Workstation System

Date of product introduction: 1/87

System Configuration:

Manufacturer: Hewlett–Packard
Operating System: UNIX V.3
Communication Protocols: Ethernet, TCP/IP
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
8.0 Mbyte main memory included. Expandable to 48 Mbyte at an increase of $52000

No storage included. Expandable to 6850 Mbyte

Workstation Configuration:

Manufacturer: Hewlett–Packard
1280 x 1024 resolution. 256 displayable colors

Comments:
3D solid modeling system

8710-1316-3417 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $69500

Model: 9000 Series, 825 SRX
Type: Technical Workstation System

Date of product introduction: 5/87

System Configuration:

Manufacturer: Hewlett-Packard
Operating System: UNIX V.3
Communication Protocols: Ethernet, TCP/IP
Microprocessor: HP-PA Coprocessor: prop.
Word size: 32
8.0 Mbyte main memory included. Expandable to 48 Mbyte at an increase of $52000
571 Mbyte disk memory included. Expandable to 6850 Mbyte

Workstation Configuration:

Manufacturer: Hewlett-Packard
1280 x 1024 resolution. 256 displayable colors
Upgrade description: both dual screen and 16.7 million displayable colors available

CAD Application Software:
three-dimensional, solid modeling

Comments:
Above is for typical system, which includes X-Windows. Drawing speed: 63,000 vectors/second

8710-1316-5027 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $42500

Model: 9000 Series, 825 S
Type: Host Computer System

Date of product introduction: 5/87

System Configuration:

Manufacturer: Hewlett-Packard
Operating System: UNIX V.3
Communication Protocols: Ethernet, TCP/IP
Microprocessor: HP-PA Coprocessor: prop.
Word size: 32
8.0 Mbyte main memory included. Expandable to 56 Mbyte at an increase of $60000

No storage included. Expandable to 6850 Mbyte
1 workstations included. 64 users maximum

Comments:
HP-PA is HP's RISC processor. Compatible with 9000 Series 300 workstations. Includes 6-channel MUX, 7 I/O channel slots, 7 expansion slots, 16-user operating system

8718-1316-3723 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $81500

Model: 9000 Series, 840 S
Type: Host Computer System

Date of product introduction: 9/86

System Configuration:

Manufacturer: Hewlett-Packard
Operating System: UNIX V.3
Communication Protocols: Ethernet, TCP/IP
Microprocessor: HP-PA Coprocessor: prop.
Word size: 32
8.0 Mbyte main memory included. Expandable to 96 Mbyte
571 Mbyte disk memory included. Expandable to 6850 Mbyte

128 users maximum

Comments:
Includes 12 I/O slots, battery backup, and 32-user operating system.
Based on HP-PA RISC processor, which includes 48-bit and 64-bit virtual addressing

0710-1317-1402 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $200000

Model: 9000 Series, 850S
Type: Host Computer System

Date of product introduction: 6/87

System Configuration:

Manufacturer: Hewlett-Packard
Operating System: UNIX V.3
Communication Protocols: Ethernet, TCP/IP
Microprocessor: HP-PA Coprocessor: prop.
Word size: 32
16.0 Mbyte main memory included. Expandable to 128 Mbyte
571 Mbyte disk memory included. Expandable to 6850 Mbyte

128 users maximum

6710-1317-1819 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $8000

Model: Electronic Engineer, Design Capture
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

CAD Application Software:
schematic capture

Prerequisites:
Runs on HP 9000, Series 300, Series 800

Comments:
Includes object-oriented data base language, generic library

8710-1315-0343 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $2000

Model: Electronic Engineer, Symbol Libraries
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

Comments:
Symbol libraries for design capture system: TTL, $2,000; MOS, $1,000; ECL, $1,000; microprocessor parts, $1,500; PLD parts, $1,000

8710-1315-3708 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $18000

Model: Electronic Engineer, Design Verification
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

CAD Application Software:
logic simulation

Comments:
System includes 3 modules. Pricing on 320/330/350: design verification interface ($4,000), simulation models ($5,000), HiLo simulator ($9,000 on 320/330 or $19,000 on 350)

0710-1314-5757 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $45000

Model: Electronic Engineer, 840–based Logic Simulator
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation
Date of product introduction: 6/86

CAD Application Software:
logic simulation

Comments:
Based on HiLo from Genrad

8710-1314-5635 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $14500

Model: Electronic Engineer, Analog Workbench
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation
Date of product introduction: 6/86

CAD Application Software:
schematic capture, circuit simulation

Comments:
Options include general device libraries for $20,000 first copy, $2,000 each additional copy; Monte Carlo statistical analysis of a circuit's component tolerances for $10,000; graphic plotting of the results for $5,000

8710-1315-8726 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $5000

Model: Electronic Engineer, Fault Simulation
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation
Date of product introduction: 11/85

CAD Application Software:
fault simulation

Comments:
Pricing: $5,000 on 320/330, $12,000 on 350, $30,000 on 84000.

8710-1315-0133 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $2000

Model: Electronic Engineer, Electronic Design/Board Test
Type: CAD Application Software for PCB Layout Applications
Hardware Platform: Technical Workstation
Date of product introduction: 6/86

Comments:
Electronic design to board test interface

8710-1315-0429 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $3000

Model: Electronic Engineer, Interface to Physical Design
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

Comments:
Interface to Scicards, Calay, Racal Redac, Computervision. Right to copy, $2,400.

8710-1315-2431 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $38700

Model: Electronic Engineer, Physical Modeler
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

Comments:
Networked HiChip, $6,500; 256K memory option, $8,600

0710-1315-1000 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $10200

Model: Engineering Graphics System
Type: CAD Application Software for PCB Layout Applications
Hardware Platform: Technical Workstation
Date of product introduction: 3/83

CAD Application Software:
PCB layout, surface mount design, hybrids
drafting, electrical

Language used: Pascal

Prerequisites:
HP 9000, Series 300, Series 800

Comments:
Manual layout. Includes IGES 3.0 output ($3,000 separately), interface to HP mechanical software, photoplotter, and NC drill output. $8,160 for second copy. $1,900 for interface to HP ECAE products. $2,000 for test program generator for HP PCB test systems

8710-1315-4221 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $31000

Model: Electronic Engineer, Printed Circuit Design
Type: CAD Application Software for PCB Layout Applications
Hardware Platform: Technical Workstation
Date of product introduction: 6/86

System Configuration:

Operating System: HP-UX

CAD Application Software:
PCB layout, surface mount design, hybrids

Language used: C, Fortran

Comments:
Includes autorouting. $24,800 additional for right to copy. Based on software from Bell Northern

8710-1314-5212 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $6500

Model: Microprocessor Development
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

CAD Application Software:
CASE

Prerequisites:
9000 Series computer

Comments:
Microprocessor development system includes windowed interface to debugger, C compiler, in-circuit emulators for more than 40 microprocessors. Used with HP Teamwork/Structured Analysis

8710-1316-2504 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $8900

Model: HP Teamwork
Type: CAD Application Software
Hardware Platform: Technical Workstation

CAD Application Software:
CASE

Prerequisites:
9000 Series computer

Comments:
Provides structured documentation of software development; used with Microprocessor Development system. Includes library for generating data flow diagrams, data dictionaries, and specifications. Includes consistency checker

8710-1416-5603 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Model: Touchstone
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation, PC
Date of product introduction: 6/86

CAD Application Software:
schematic capture, circuit simulation, analog

Prerequisites:
HP Vectra PC or 9000 Series

Comments:
Software is for design of microwave products, and is from EEsof, Inc.

CAD PRODUCT DESCRIPTION

Price: $5610

Model: Mechanical Engineer, Series 5
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation
Date of product introduction: 10/85

CAD Application Software:
two-dimensional, drafting, other design/analysis

Language used: Pascal

Prerequisites:
HP 9000, Series 300, Series 800

Comments:
System prices range from $18,000 to $28,000. Compatible with ME Series 10 and 30

8710-1315-5028 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $10200

Model: Mechanical Engineer, Series 10
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation
Date of product introduction: 10/85

CAD Application Software:
two-dimensional, drafting, other design/analysis

Language used: Pascal

Prerequisites:
HP 9000, Series 300, Series 800

Comments:
System prices range from $28,000 to $52,000, depending on platform. Includes macro programming language for parametric design and design evaluation, links to NC, FEM/FEA (MARC Analysis), and DXF. Also includes APT and COMPACT II NC language output

8710-1315-5230 HEWLETT-PACKARD

CAD PRODUCT DESCRIPTION

Price: $18350

Model: Mechanical Engineer, Series 30
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation
Date of product introduction: 11/86

CAD Application Software:
two-dimensional, solid modeling, drafting
other design/analysis

Language used: Pascal, Fortran

Prerequisites:
HP 9000; Series 300, Series 800

Comments:
System prices range from $43,000 to $100,000. Can be used with HP SRX graphics. Includes ME 5 and ME 10, and commands for creating solid models from 2D geometry. Also includes links to ANSYS, Patran, and FEMGEN

CAD PRODUCT DESCRIPTION

Price: $1000

Model: HP-UX
Type: Operating System Software
Hardware Platform: Technical Workstation

Comments:
UNIX-based operating system

8710-1315-3547 HEWLETT-PACKARD

Systems

Incorporated

Information Displays, Inc.

Information Displays, Inc.
28 Kaysal Court
Armonk, New York 10504
Telephone: (914) 273-5755
(Thousands of Dollars Except Per Share Data)

Balance Sheet (December 31)

	1977	1978	1979	1980	1981
Working Capital	$ 670	$ 460	$1,903	$ 373	$4,369
Long-Term Debt	$1,279	$1,122	$2,641	$2,853	$1,436
Shareholders' Equity	$ 458	$ 343	$ 533	$ (23)	$6,715
After-Tax Return on Average Equity (%)	(31.8)	(33.7)	43.4	(218)	17.0

Operating Performance (Fiscal Year Ending December 31)

	1977	1978	1979	1980	1981
Revenue	$1,017	$2,529	$4,048	$4,267	$7,289
U.S.	N/A	N/A	$3,380	$3,948	$6,145
Non-U.S. Revenue	N/A	N/A	$ 668	$ 319	$1,144
Cost of Revenue	$ 596	$1,598	$1,740	$2,121	$3,316
R&D Expense	$ 52	$ 63	$ 388	$ 471	$ 641
SG&A Expense	$ 512	$ 851	$1,200	$1,593	$2,280
Pretax Income	$ (173)	$ (135)	$ 190	$ (556)	$ 570
Pretax Margin (%)	(17)	(5.3)	4.7	(13)	7.8
Effective Tax Rate (%)	N/A	N/A	42.0	N/A	40.6
Net Income	$ (173)	$ (135)	$ 190	$ (556)	$ 570
Average Shares Outstanding (Thousands)	386	426	735	740	2,096
Per Share					
Earnings	$ (0.45)	$ (0.34)	$ 0.15	$ (0.75)	$ 0.25
Dividends	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
Book Value	$ 1.19	$ 0.81	$ 0.72	$ (0.03)	$ 3.20
Price Range	N/A	N/A	$ 2- 5 3/4	$ 2- 8 1/2	$ 4 1/2- 9 3/4
Total Employees	N/A	N/A	N/A	63	N/A

N/A = Not Available

Source: Information Displays, Inc., 1981 Annual Report and Prospectus

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Information Displays, Inc.

(Much of this material was excerpted from the Information Displays, Inc., 1981 Annual Report and Prospectus. For more detailed information and opinions about Information Displays, Inc., DATAQUEST clients are invited to use their inquiry service privileges.)

THE COMPANY

Background

Information Displays, Inc. (IDI), was founded in New York in 1945 as RMS Associates, Inc., and adopted its present name in 1964. From its origin to 1964, the Company manufactured electronic equipment, and rendered engineering and consulting services. From 1964 to 1975, IDI sold computer graphics systems for military applications. In 1975 the Company began developing turnkey systems for the CAD/CAM industry, sales of which began in 1977.

Operations

In early 1982, IDI moved its corporate headquarters and manufacturing operations to Armonk, New York, combining operations previously located in White Plains and Elmsford, New York. The new facility provides increased production capacity, with an addition scheduled for completion in 1983. All IDI facilities are leased.

A stock offering in July 1981 generated $4.2 million, considerably strengthening IDI's financial position. The Company also received an industrial bond commitment of $1.25 million for machinery, equipment, and facilities improvement.

IDI's manufacturing activities primarily consist of the fabrication of Company-designed electronic circuits, and the assembly and testing of parts, components, and sub-assemblies purchased from vendors.

As of April 30, 1981, IDI had 63 employees. Approximately 45 employees are located in the New York area, and the remainder are located in the Company's sales and service offices.

International Operations

During the fiscal year ending December 31, 1981, non-U.S. sales, primarily in Western Europe, totalled $1.14 million, or 15.7 percent of total revenue. In 1981, IDI added a distributor in Japan in an effort to expand its overseas market share.

Information Displays, Inc.

Marketing

IDI markets its systems through a direct sales force in the United States and through independent distributors in Western Europe. The Company has sales offices in New York, Chicago, San Francisco, and Los Angeles, and plans to open additional offices in Houston and Atlanta in 1982.

The Company plans additional sales and development staffing in 1982. In mid-1981, IDI had 13 employees engaged in marketing, sales, and sales support activities.

IDI had a backlog on March 31, 1981, of approximately $1,600,000 compared with approximately $750,000 a year earlier. The Company also had maintenance contracts outstanding for future services valued at $400,000, compared with approximately $250,000 a year earlier.

Research and Development

In October 1981, a newly formed, wholly owned subsidiary of the Company, IDI Development Corporation, became the general partner of a California limited partnership, CAD/CAM Partners. The partnership was organized for research and development of a microprocessor-based, stand-alone, intelligent interactive graphics workstation (IGWS). Participation in the limited partnership enables IDI to use previously allocated R&D funds for working capital purposes.

CAD/CAM ACTIVITIES

Graphics Systems

IDI graphic systems consist of a Sperry-Univac minicomputer, CRT display, display controller, programmer's console, disk drive, magnetic tape unit, operating system software, and various applications packages. The display unit uses vector refresh technology.

IDI offers communications capabilities to link two or more of its systems or to link IDI's systems with the customer's own computer.

Applications

IDI concentrates in three major application areas:

- Technical documentation/illustration

Information Displays, Inc.

- Electrical and mechanical drafting
- Architecture, engineering, and construction

Specialized application software has been developed to meet customers' needs.

Technical Documentation/Illustration

IDI has developed the Graphics Design Illustrator. This system is specifically oriented to the publications industry and offers automation of technical illustrations from initial drawing creation on the display screen through actual merging of drawings and associated text on a CRT phototypesetter. The system eliminates the manual process that involves cutting, pasting, drawing changes, and merging of text with graphics.

Electrical and Mechanical Drafting

IDI software automates the mechanics of drafting such as line drawing, lettering, cross-hatching, and dimensioning for applications such as printed circuit board layout, bottle design, two-dimensional mechanical and electrical drafting, electrical ladder diagrams, and network analysis.

AEC

IDI's AEC system provides design, drafting, and data management for construction projects, space planning, and layout. The Company's system is used to produce electrical and structural diagrams, heating, ventilation, and air conditioning drawings, and provides full support for linear and angular measurements and dimensioning.

New Product Development

At present, the Company is developing a microprocessor-based, stand-alone intelligent interactive graphics workstation (IGWS). The IGWS will locally incorporate sufficient processing power and storage to enable the user to perform all necessary tasks without using the interactive processing resources of a minicomputer or other host computer. The IGWS consists of nine microprocessors in a multiprocessing environment combining 16-, 32-, and 48-bit architectures. The controlling processor in the IGWS is the Motorola 68000.

The IGWS will combine a vector refresh display with a color graphics raster display. The vector refresh display is the operator's primary visual interface. The color graphics raster display provides an overview capability, permitting color separation to highlight or accentuate special attention areas on the drawing. The color overview provides a constant picture of the drawing while detailed work is being performed on the drawing that appears on the vector refresh display.

The advantages of the IGWS stand-alone workstation are:

- It has increased speed.
- Downtime at any one workstation does not affect any other station.
- It may be available in a variety of configurations:
  - Offered as a stand-alone unit for a single user
  - Offered as a stand-alone unit integrated into existing computer networks
  - Located any place, needing only a telephone connection to communicate to other systems or to a host computer
  - Hooked into existing timesharing systems
  - Offered as a turnkey system with a centralized processing facility
- It allows a large number of workstations to be hooked onto a central computing facility (mini or mainframe) with minimal impact on central facility resources, as the central facility is used only for archiving drawings.
- It permits the incorporation of design and analysis programs currently running on mini or mainframe computers, thus providing a total drawing/design environment at the local user level.

Customer Support

IDI has 15 employees engaged in the following customer support activities:

- Field Engineering—IDI has field service employees in New York, Baltimore, St. Louis, Los Angeles, San Francisco, and Detroit. In addition, IDI maintains a "hot line" to respond to customers' problems and offers penalty payment if the Company fails to make a system operational within 24 hours of notice of system failure. The penalty is $200 per day for a maximum of five days. Penalty payments to date have been insignificant.

  Field engineers install the Company's products, perform preventive maintenance and repair service, and are available for general assistance in solving customer hardware and software operating problems. Most of IDI's customers purchase a maintenance contract under which the

Company provides all hardware and software maintenance services for a fixed monthly charge. The Company's independent distributors provide all direct maintenance for the systems sold in Europe.

- Education and Training—IDI provides ongoing training of its customers' operating personnel. Training courses are generally held at the customer's facility.

- Users' Organization—IDI's customers have organized a users' group in which all customers automatically become members. The users' group provides an important function in the exchange of information among customers, and furnishes useful suggestions to the Company for new applications software. It is also an effective quality control forum for IDI management.

Intergraph Corporation

Intergraph Corporation

Intergraph Corporation
One Madison Industrial Park
Huntsville, Alabama 35807
Telephone: (205) 772-2000 Telex: 810-726-2180
(Millions of Dollars Except Per Share Data)

Balance Sheet (December 31)

	1981	1982	1983	1984	1985	CAGR 1981-1985
Working Capital	$ 38.6	$ 40.0	$ 124.1	$ 178.1	$ 317.5	69.4%
Long-Term Debt	$ 5.9	$ 2.1	$ 10.6	$ 10.2	$ 10.6	15.7%
Shareholders' Equity	$ 50.4	$ 65.4	$ 162.0	$ 232.7	$ 403.0	68.2%
After-Tax Return on Average Equity (%)	25.6%	22.5%	25.8%	31.9%	21.3%	

Operating Performance (Fiscal Year Ending December 31)

	1981	1982	1983	1984	1985	
Revenue	$ 91.1	$ 155.6	$ 252.0	$ 403.8	$ 526.4	55.0%
U.S. Revenue	$ 67.0	$ 104.3	$ 178.9	$ 282.7	$ 363.2	52.6%
Non-U.S. Revenue	$ 24.1	$ 51.3	$ 73.1	$ 121.1	$ 163.2	61.3%
Cost of Goods Sold	$ 47.7	$ 78.8	$ 123.4	$ 191.0	$ 266.3	57.3%
Gross Margin	$ 43.4	$ 76.8	$ 128.6	$ 212.8	$ 260.1	56.5%
Expenses	$ 29.4	$ 51.9	$ 75.4	$ 104.2	$ 150.8	50.5%
R&D Expense	$ 12.0	$ 19.7	$ 28.2	$ 37.1	$ 50.7	43.4%
SG&A Expense	$ 17.4	$ 32.2	$ 47.2	$ 67.1	$ 100.1	54.9%
Operating Income	$ 14.0	$ 25.0	$ 53.2	$ 108.6	$ 109.3	67.1%
Interest Expense	($ 0.5)	($ 1.0)	($ 0.3)	($ 3.2)	($ 1.0)	18.8%
Interest Income	$ 2.4	$ 1.4	$ 5.8	$ 9.5	$ 9.5	40.6%
Other Income (Expense)	$ 0.3	($ 0.1)	($ 1.0)	($ 5.3)	$ 0.8	25.5%
Income before Tax	$ 16.2	$ 25.3	$ 57.7	$ 109.6	$ 118.5	64.4%
Pretax Margin (%)	17.8%	16.2%	22.9%	27.1%	22.5%	
Taxes	$ 8.0	$ 12.3	$ 28.5	$ 46.6	$ 50.8	58.9%
Effective Tax Rate (%)	49.1%	48.5%	49.3%	42.5%	42.8%	
Extraordinary Credit						
Net Income after Tax	$ 8.3	$ 13.0	$ 29.3	$ 63.0	$ 67.8	69.2%
Shareholder Data*						
Average Shares Outstanding (Millions)	22.1	23.2	50.5	51.6	54.3	25.2%
Per Share						
Earnings	$ 0.37	$ 0.56	$ 0.58	$ 1.22	$ 1.25	35.6%
Dividend	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	N/M
Book Value	$ 2.28	$ 2.82	$ 3.21	$ 4.51	$ 7.42	34.3%
Price Range	$ 9 1/2-16 1/2	$ 7 7/8-25 3/8	$ 38 1/4-44 7/8	$ 16 1/2-28 1/2	$ 21-38.0	
Total Employees	1,275	1,800	2,500	3,700	5,100	41.4%
Revenue Per Employee	$71,449	$86,444	$100,806	$109,135	$103,217	9.6%

*1983-1985: adjusted to reflect the two-for-one stock split in 1985
N/M = Not Meaningful

Source: Intergraph Corporation
Dataquest
September 1986

Line Items as a Percent of Revenue

	1978	1979	1980	1981	1982
Operating Performance					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	73.5%	67.0%	71.0%	70.0%	69.0%
Non-United States	26.5%	33.0%	29.0%	30.0%	31.0%
Cost of Goods Sold	52.4%	50.6%	49.0%	47.3%	50.6%
Gross Margin	47.6%	49.4%	51.0%	52.7%	49.4%
Expenses	32.2%	33.4%	29.9%	25.8%	28.6%
R&D Expense	13.1%	12.7%	11.2%	9.2%	9.6%
SG&A Expense	19.1%	20.7%	18.7%	16.6%	19.0%
Other Expense	0.0%	0.0%	0.0%	0.0%	0.0%
Operating Income	15.4%	16.0%	21.1%	26.9%	20.8%
Interest Expense	(0.6%)	(0.6%)	(0.1%)	(0.8%)	(0.2%)
Interest Income	2.7%	0.9%	2.3%	2.4%	1.8%
Other Income (Expense)	0.3%	(0.1%)	(0.4%)	(1.3%)	0.1%
Income before Tax	17.8%	16.2%	22.9%	27.1%	22.5%
Taxes	8.7%	7.9%	11.3%	11.5%	9.6%
Net Income after Tax	9.1%	8.4%	11.6%	15.6%	12.9%

Source: Intergraph Corporation
Dataquest
September 1986

THE COMPANY

Founded

Intergraph Corporation was incorporated in Alabama in 1969 as M&S Computing, Inc., a privately held company. The Company initially developed computer software and hardware for the U.S. Department of Defense and the National Aeronautics and Space Administration. The early systems were used primarily for mapping and civil engineering. In 1980, M&S Computing, Inc., changed its name to Intergraph Corporation to better reflect the Company's expanded scope.

Historically, Intergraph derived most of its revenue from systems utilized in land use and resource management, cartography, utility facility management, plant design, energy exploration, and architectural and engineering design. In recent years, however, Intergraph has developed systems for use in mechanical design and manufacturing, electronic design and manufacturing, and technical publications.

Positioning

Intergraph sells and supports turnkey systems in all CAD/CAM applications and derives all of its revenue from CAD/CAM markets. The Company's performance and market share history are shown in Tables 1 and 2.

Table 1

Intergraph Corporation
CAD/CAM Performance
(Millions of Dollars/Actual Units)

	1981	1982	1983	1984	1985
Revenue	$73	$127	$250	$404	$526
Workstations Shipped	729	1,721	1,845	3,198	5,144
Workstations Installed	1,928	3,553	5,269	8,208	13,105

Source: Dataquest
September 1986

Table 2

Intergraph Corporation
CAD/CAM Market Share History
(Percent Market Share by Segment)

	1981	1982	1983	1984	1985	1985 Rank in Market
All Applications						
Revenue	7%	9%	12%	11%	11%	2
Workstations Shipped	10%	16%	11%	6%	6%	3
Mechanical						
Revenue	0%	0%	4%	5%	6%	3
Workstations Shipped	0%	2%	4%	3%	3%	4
AEC						
Revenue	28%	36%	39%	31%	27%	1
Workstations Shipped	26%	36%	33%	10%	10%	1
Mapping						
Revenue	24%	28%	39%	40%	61%	1
Workstations Shipped	45%	62%	66%	68%	67%	1
PCB						
Revenue	0%	0%	4%	6%	5%	6
Workstations Shipped	0%	0%	3%	4%	3%	7

Source: Dataquest
September 1986

FINANCIAL

Financing

An initial public stock offering took place in April 1981, underwritten by Dean Witter Reynolds and The Robinson-Humphrey Company. Net proceeds to the Company were approximately $28 million.

In April 1985, a second public offering occurred, yielding $88 million. The offering was underwritten by Salomon Brothers and The Robinson-Humphrey Company.

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- August 1986—Intergraph introduced an addition to the 200 computer series, the Model 252, based on two MicroVAX II computers from Digital Equipment Corporation.

- June 1986—Intergraph announced three new analog design tools: both linear and nonlinear analog circuit simulation and the Company's proprietary Analog Workbench, which provides software-generated test equipment such as voltmeters, oscilloscopes, and function generators.

- June 1986—The Company unveiled two workstations based on the Fairchild RISC microprocessor: the Interpro 32C and the Interact 32C, which is a dual graphic display version of the Interpro 32C.

- June 1986—Intergraph announced that it had purchased exclusive rights to a routing technology developed by ECAD Inc. of San Jose, California.

- June 1986—The Company announced an agreement to acquire a 50 percent interest in CNR Research Company of Ann Arbor, Michigan.

- June 1986—Intergraph acquired the scanning technology and product line of Industrial Vision Systems of Lowell, Massachusetts.

- March 1986—The Company acquired Optronics International, a Chelmsford, Massachusetts, manufacturer of image scanning and recording products.

- March 1986—Intergraph announced an agreement to acquire Circuit Tools, Inc., and its CSPICE analog nonlinear circuit simulation program.

- February 1986—The Company introduced the Intergraph 8650, based on Digital Equipment's VAX 8650 computer.

- November 1985—Intergraph introduced the 200 series of computers, which supports up to 12 users and is based on Digital Equipment's MicroVAX II.

- November 1985—Intergraph announced the availability of standard cell libraries from NCR/Motorola on the Tancell automatic cell-based IC design system.

- August 1985—The Company announced that it would buy 50 percent ownership of Tangent Systems of Sunnyvale, California.

- June 1985—Intergraph introduced the Micro II computer, which supports up to four users and is based on Digital's MicroVAX II.

- June 1985—Intergraph announced the InterMap Analytic, a photogrammetric workstation that combines the Company's proprietary graphics workstation with Zeiss' analytical stereoplotter.

- June 1985—Intergraph unveiled a robot modeling and programming system for VAX-based systems, developed in conjunction with GMF Robotics Corporation.

- June 1985—The Company demonstrated Intergraph/Rand-Micas, finite-element analysis software available on VAX-based Intergraph systems. The software was developed by The Rand Group, an Intergraph subsidiary.

- June 1985—The Company entered the EDA market with software for MicroVAX- and VAX-based systems.

- June 1985—Intergraph announced the availability of standard cell libraries from Gould AMI and International Microelectronic Products on the Tancell automatic IC design system.

- June 1985—The Company unveiled the PCB Micro II system for printed circuit board (PCB) design.

- January 1985—Intergraph announced an agreement to acquire The Rand Group of Dallas, Texas.

- 1985—The Company adopted the Ethernet network standard and UNIX System V.

ORGANIZATION

Personnel

Intergraph has 5,600 employees worldwide, 900 of whom are in field service.

Facilities

Intergraph's Huntsville, Alabama, headquarters are used for R&D, management, manufacturing, and warehousing. The Company is also building an assembly and distribution facility in the Netherlands. Intergraph occupies or has under construction 1,179,700 square feet in Huntsville, Alabama; 194,500 square feet in other U.S. locations; and 506,100 square feet in other countries.

MARKETING AND SALES

Strategy

Intergraph's recent introduction of the 32C workstations represents a significant strategic risk in a market that favors standard platforms on commodity products from computer vendors. Intergraph's new 32C offers excellent price/performance, but the decision to build rather than buy its computing hardware commits the Company to a significant R&D effort in order to stay current in workstation technology. In return, however, the Company can avoid being pushed toward unbundled software sales, a trend which is eroding the profit margins of competitors.

Of course, the Company must also successfully move its applications software to the new platform. Currently, only Intergraph's electronic CAD applications run locally on the new workstations. Intergraph's core IGDS and DMRS software, which account for greater than 90 percent of its revenue, are not available for the new workstations because these applications are based on Digital's VMS operating system. Dataquest expects, however, that Intergraph will soon introduce a new core graphics system called the Intergraph Graphics Environment (IGE) that will retain most of the IGDS and DMRS functionality and utilize an object-oriented data structure.

Distribution and Sales

Intergraph systems are sold in the United States by the Company's direct sales force. In other countries, products are sold both directly and through distributors. The U.S. sales territory is divided into five regions, with regional offices in Atlanta, Detroit, Dallas, Los Angeles, and Washington, D.C. Intergraph maintains sales locations in 51 U.S. cities and 23 non-U.S. countries, and a demonstration center at its Huntsville, Alabama, headquarters. Distributors represent the Company in Argentina, Brazil, India, Saudi Arabia, and portions of Japan.

Intergraph's customer support center in the Netherlands is the hub of European and Middle Eastern support operations, providing customer training, customer support, systems staging, and systems delivery. It also maintains an inventory of spare parts and systems modules.

SALES SUPPORT

Warranties

Intergraph offers a 30-day warranty on systems.

Maintenance Agreements

The Company offers three basic maintenance agreements: a full-service yearly contract, a per-call contract, and an on-site resident contract. Hardware and applications software are included in all maintenance agreements, with a separate monthly charge for core software and third-party software. Response time is generally within eight hours.

Training

Training is offered primarily at the Company's Huntsville, Alabama, headquarters, or at the customer's site on request. Training courses range from three days to two weeks in length, with a one-week average.

STRATEGIC ALLIANCES

Mergers and Acquisitions

In June 1986, Intergraph announced that it had purchased exclusive rights to a routing technology developed by ECAD Inc. of San Jose, California. The Company will sell this product as the Tiger Router.

Also in June 1986, the Company announced an agreement to acquire a 50 percent interest in CNR Research Company of Ann Arbor, Michigan. Intergraph will market CNR's AEC drafting product for the Interpro 32 as Micro-IGDS, while CNR will continue to market the PC-DOS version of the package.

In another acquisition in June 1986, Intergraph acquired the scanning technology and product line of Industrial Vision Systems (IVS) of Lowell, Massachusetts. The IVS large-format document scanner will be part of the Optronics product line.

In March 1986, the Company acquired Optronics International, Inc., a Chelmsford, Massachusetts, manufacturer of image-scanning and recording products. Intergraph has begun offering Optronics' L-2420 Laser Photoplotter raster film recorder used in printed circuit board applications.

Also in March 1986, Intergraph announced an agreement to acquire Circuit Tools, Inc., and its CSPICE analog nonlinear circuit simulation program.

In August 1985, Intergraph announced that it would buy 50 percent ownership of Tangent Systems of Sunnyvale, California. The two companies have jointly developed Tancell cell-based IC software to be sold by Intergraph.

In January 1985, the Company announced an agreement to acquire The Rand Group of Dallas, Texas. The Rand Group produces Rand-Micas, a finite-element analysis software package.

OEM Agreements

In August 1985, the Company agreed to remarket Isogen, an isometric 3-D piping package from Imperial Chemical Industries of England. Bowing to the popularity of Isogen, Intergraph broke its usual policy of not offering third-party AEC software.

The Company also has an OEM agreement with GenRad of Concord, Massachusetts, for HILO-3 simulation software.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- 1984—Intergraph announced the Interpro 32, a host-dependent workstation for the Company's VAX-based CAD software that also runs UNIX and MS-DOS locally.
- 1984—The Company introduced MEMS, a mechanism modeling system to prepare models for input to third-party analysis programs.
- 1983—Intergraph introduced a family of graphics workstations:
    - Interact, a dual-screen workstation targeted at the design and drafting production environment
    - Interpro, a desktop workstation for the office enrivonment
    - Intermap, a stereodigitizing and general mapping workstation
    - Interpage, a technical publications system
- 1983—The Company announced the Graphics Processor to support complex graphics operations such as solids modeling.
- 1982—Intergraph announced the Advanced Series workstations, which use the Motorola 68000 microprocessor.

- 1981—The Company announced the photogrammetric workstation, the Company's first device designed to digitize information from stereophotographs.
- 1980—Intergraph introduced the Raster Tube, the Company's first workstation based on raster technology.
- 1974—The Company introduced a dual-screen workstation.
- 1973—The Company sold its first interactive graphics system.
- 1972—Intergraph shipped its first host-dependent workstation.

CAD/CAM PRODUCTS

Product Line

Intergraph sells and supports turnkey systems in all CAD/CAM applications. For high-end systems, the Company combines its software and host-dependent graphics workstations with computers from Digital Equipment Corporation and peripherals manufactured by other vendors. Selected CAD software also runs locally on the Company's proprietary workstations, under UNIX.

Intergraph's software is generally compatible across CAD applications. For example, the Company's PCB layout software interfaces to both its EDA and its mechanical software, thus allowing users to integrate PCB mechanical and electronic design, simulation, and analysis. In electronic applications, a conversion program converts files in both directions between UNIX and Digital Equipment's VMS. Additional electronics software is regularly being ported to the UNIX environment.

Intergraph also manufactures various hardware products designed to improve performance of its 200 Series, such as the Graphics Processor and Communication Processor.

The Company's products are shown in Table 3.

Table 3

Intergraph Corporation
Products

HOST COMPUTERS

Model	Description
200 Series	System based on MicroVAX II (up to 12 users); enhanced with additional graphics, communications, and file server processors (Model 252 is a dual-CPU system for applications requiring high availability or reliability.)
Micro II, Intergraph 785, Intergraph 8650	System based on Digital Equipment's MicroVAX II (up to 4 users), VAX 11/785, or VAX 8650

HOST-DEPENDENT AND STANDALONE WORKSTATIONS

Model	Micro-processor	Resolution	Comment
Interpro 32C	CLIPPER	1,184 x 884	Runs Intergraph's EDA software locally under UNIX; operates as host-dependent workstation for IGDS, DMRS, IEDS, Tancell, or EDA software running under Digital Equipment's VMS; PC-DOS included
Interact 32C	CLIPPER	1,184 x 884	Dual-display version of Interpro 32C
Interpro 32, Interact 32	32032	1,184 x 884	Currently available precursor to 32C models; offers functions listed above at a slower speed

APPLICATION SOFTWARE

Model	Function
IGDS and DMRS	Intergraph Graphic Design System and Data Management and Retrieval System; core graphics and data base software running under VMS for mechanical, AEC, and mapping applications
Micro-IGDS	UNIX-based AEC drafting system for Interpro workstations; compatible with IGDS

(Continued)

Table 3 (Continued)

Intergraph Corporation
Products

APPLICATION SOFTWARE (Continued)

Model	Function
AEC	Based on IGDS and DMRS; functions include 3D modeling, facilities management, strategic planning, equipment modeling, P&ID, structural, HVAC, electrical, piping, concrete, and steel
Mapping	Based on IGDS and DMRS; functions include surface, subsurface, and networks mapping
Mechanical	Based ON IGDS and DMRS; functions include solid modeling, numerical control, nesting, flat pattern, image processing, mechanisms, production planning, and robotics (A third-party molds package is also available.)
Intergraph/ Rand-Micas	Based on IGDS and DMRS; finite-element analysis package
Hierarchical Schematic Design	Schematic capture package for PCB or cell-based IC design; hierarchy divides design into manageable components; runs under either UNIX or VMS
Simulation	For PCB applications; Packages include digital logic and fault simulation (HIL03), nonlinear analog circuit simulation (CSPICE), and linear analog circuit simulation; runs under either UNIX or VMS
Analog Workbench	Tools include software-generated oscilloscope, voltmeter, and function generator; interfaces to Intergraph simulation packages
IEDS	PCB design modules; include auto place, Tiger Router (first module expected to be ported to UNIX), hybrids, Multiwire, numerical control, wire wrap, auto insertion, and automatic test equipment interface; run under VMS
Tancell, Tansure, Tantest	Cell-based IC design software with packages for either UNIX or VMS (Tancell performs layout and verification. Tansure corrects the design to meet timing requirements. Tantest adds circuit elements to make the design testable and also generates a test program.)

Source: Intergraph Corporation
Dataquest
September 1986

IBM Corporation

IBM Corporation

IBM Corporation
Armonk, New York 10504
Telephone: (914) 765-1900 Telex: 137405
(Millions of Dollars Except Per Share Data and Employee Data)

Balance Sheet (December 31)

	1981	1982	1983	1984	1985	CAGR 1981-1985
Working Capital	$ 2,983	$ 4,805	$ 7,763	$ 10,735	$ 14,637	48.8%
Long-Term Debt	$ 2,669	$ 2,851	$ 2,674	$ 3,269	$ 3,955	10.3%
Shareholders' Equity	$ 18,161	$ 19,960	$ 23,219	$ 26,489	$ 31,990	15.2%
After-Tax Return on Average Equity	18.1%	21.6%	25.4%	26.5%	22.4%	
OPERATING PERFORMANCE						
Revenue	$ 29,070	$ 34,364	$ 40,180	$ 45,937	$ 50,056	14.6%
U.S. Revenue	$ 15,088	$ 19,028	$ 23,127	$ 27,371	$ 28,511	17.2%
Non-U.S. Revenue	$ 13,982	$ 15,336	$ 17,053	$ 18,566	$ 21,545	11.4%
Cost of Goods Sold	$ 12,016	$ 13,688	$ 16,395	$ 18,919	$ 21,103	15.1%
Gross Margin	$ 17,054	$ 20,676	$ 23,785	$ 27,018	$ 28,953	14.1%
Expenses	$ 11,027	$ 12,620	$ 14,196	$ 15,787	$ 17,723	12.6%
R&D Expense	$ 1,612	$ 3,042	$ 3,582	$ 4,200	$ 4,723	30.8%
SG&A Expense	$ 9,415	$ 9,578	$ 10,614	$ 11,587	$ 13,000	8.4%
Operating Income	$ 6,027	$ 8,056	$ 9,589	$ 11,231	$ 11,230	16.8%
Interest Expense	$ 407	$ 454	$ 390	$ 408	$ 443	2.1%
Interest Income	$ 368	$ 328	$ 741	$ 800	$ 832	22.6%
Income before Tax	$ 5,988	$ 7,930	$ 9,940	$ 11,623	$ 11,619	18.0%
NOTE: Pretax Margin	21%	23%	25%	25%	23%	
Taxes	$ 2,850	$ 3,813	$ 4,455	$ 5,041	$ 5,064	15.5%
NOTE: Effective Tax Rate	48%	48%	45%	43%	44%	
Extraordinary Credit						
Net Income after Tax	$ 3,138	$ 4,117	$ 5,485	$ 6,582	$ 6,555	20.2%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	587.8	596.7	606.8	611.4	614.1	1.1%
Per Share Data						
Earnings	$ 5.63	$ 7.39	$ 9.04	$ 10.77	$ 10.67	17.3%
Dividends	$ 3.44	$ 3.44	$ 3.71	$ 4.10	$ 4.40	6.3%
Book Value	$ 30.90	$ 33.45	$ 38.26	$ 43.33	$ 52.09	14.0%
Price Range (Low)	$ 48 3/8-	$ 55 5/8-	$ 92 1/4-	$ 99.00-	$ 117.38-	
(High)	71 1/2	98	104 7/8	128.50	158.75	
TOTAL EMPLOYEES	354,936	364,796	369,545	394,930	405,535	3.4%
Revenue Per Employee	$ 81,902	$ 94,201	$108,728	$116,317	$123,432	10.8%

Source: IBM Corporation
Dataquest
August 1986

IBM Corporation
Armonk, New York 10504
Telephone: (914) 765-1900

Line Items As A Percent Of Revenue

	1981	1982	1983	1984	1985
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
U.S. Revenue	51.9%	55.4%	57.6%	59.6%	57.0%
Non-U.S. Revenue	48.1%	44.6%	42.4%	40.4%	43.0%
Cost of Goods Sold	41.3%	39.8%	40.8%	41.2%	42.2%
Gross Margin	58.7%	60.2%	59.2%	58.8%	57.8%
Expenses	37.9%	36.7%	35.3%	34.4%	35.4%
R&D Expense	5.5%	8.9%	8.9%	9.1%	9.4%
SG&A Expense	32.4%	27.9%	26.4%	25.2%	26.0%
Operating Income	20.7%	23.4%	23.9%	24.4%	22.4%
Interest Expense	1.4%	1.3%	1.0%	0.9%	0.9%
Interest Income	1.3%	1.0%	1.8%	1.7%	1.7%
Income before Tax	20.6%	23.1%	24.7%	25.3%	23.2%
Taxes	9.8%	11.1%	11.1%	11.0%	10.1%
Net Income after Tax	10.8%	12.0%	13.7%	14.3%	13.1%

Source: IBM Corporation
Dataquest
August 1986

THE COMPANY

Founded

International Business Machines Corporation was incorporated in New York in June 1911, as the Computing-Tabulating-Recording Company, a consolidation of four companies. These four companies were Computing Scale Company of America, Tabulating Machine Company, International Time Recording Company of New York, and Bundy Manufacturing Company. In 1924, Computing-Tabulating-Recording Company adopted the name of International Business Machines (IBM) Corporation.

Positioning

IBM is the world's largest manufacturer of data processing machines and information handling systems. Hardware used in CAD/CAM includes host systems using the 5080 graphics system, the RT PC, and the PC AT. Software is available for mechanical, AEC, mapping, EDA, and PCB applications. IBM is in the unique position of being both the market leader and an important user of CAD/CAM. In recent years the Company has invested heavily in internal industrial automation.

The Company has been the leader in CAD/CAM revenue market share since 1983. Dataquest estimates that IBM's direct CAD/CAM revenue was $870 million in 1985, a 24 percent increase from 1984's CAD/CAM revenue of $700 million. IBM systems are primarily sold for mechanical design applications; Dataquest estimates that 90 percent of IBM's 1985 CAD/CAM revenue was derived from this source.

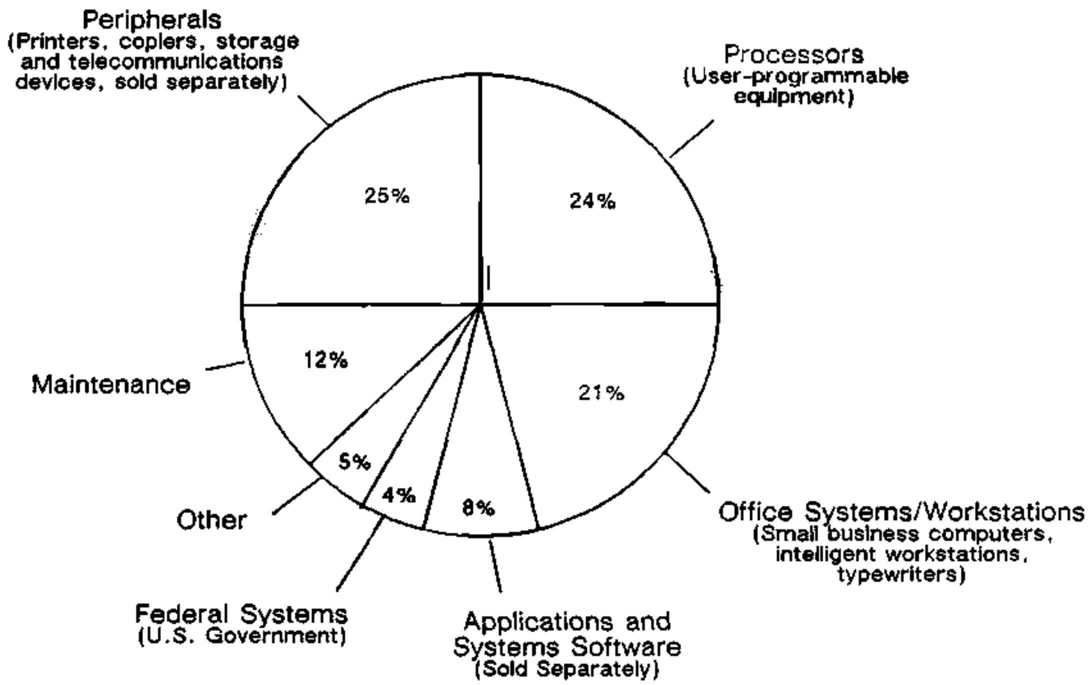
FINANCIAL

Revenue

IBM's 1985 revenue by product class are shown in Figure 1.

Figure 1

IBM Corporation
Revenue by Product Class
1985



Note: Percentages may not total 100 due to rounding.

Source: IBM Corporation
Dataquest
August 1986

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- June 1986—The Company announced CIEDS/Design Simulation for host computers, to be available in the fourth quarter of 1986. The software package will include core software and four modules: behavioral simulation, logic simulation, analog-digital simulation, and switched capacitor IC simulation.

- June 1986—IBM announced MICRO CADAM, a 2-1/2 dimensional mechanical design package for the PC AT. MICRO CADAM functions are a subset of those found in CADAM.

- June 1986—The Company significantly enhanced communications for the RT PC by announcing connections to both Ethernet with TCI/IP and the IBM Token-Ring networks. It announced the Multi-Protocol Communications Adapter, which allows the RT PC to attach a variety of data communications equipment.

- June 1986—The Company announced a Numerical Control Postprocessor that interfaces to CADAM and CATIA through APT-AC files.

- May 1986—The Company made CAEDS solid and finite element modeling software available for the RT PC.

- April 1986—IBM's CAD/CAM, computer integrated manufacturing, industrial personal computers, and robotics products were combined under the direction of one Independent Business Unit, called Industry Systems Products.

- January 1986—The Company announced the RT PC computers, which use Reduced Instruction Set Computer (RISC) architecture. Based on a proprietary 32-bit microprocessor, the RT PC can also be configured with a 5080 system to provide a standalone or host-dependent CAD workstation. The RT PC runs under AIX, a proprietary operating system based on UNIX System V. CAD/CAM software includes RT versions of CADAM, CIEDS, graPHIGS, and technical publishing software. Several key CAD/CAM features will be available in September 1986.

- January 1986—IBM announced Design Capture, a schematic capture program that is the Company's first entry in its new Computer-Integrated Electrical Design Series (CIEDS) line. Design Capture is licensed from Silvar-Lisco and is based on Silvar-Lisco's Structured Design System. It spans host-dependent, standalone, and personal computer platforms, including the RT PC.

- November 1985—The Company announced Data Communications Service (DCS), software that combines relational data base management and communications networking. DCS facilitates the consolidation and sharing of data across IBM hosts from such programs as CAEDS, CATIA, CADAM, and CIEDS.

- November 1985—The Company unveiled graPHIGS, a program based on the ANSI-proposed Programmers Hierarchical Interactive Graphics System (PHIGS). The PHIGS standard defines a set of functions designed to permit device-independent programming of three-dimensional graphics, and is particularly targeted toward CAD/CAM applications.

- October 1985—IBM announced a vector processing facility (VF) for the 3090 host computer. VF applications are used in CAD analysis and simulation applications.

- May 1985—IBM Japan announced MICRO CADAM, a version of CADAM applications software that is sold with IBM PCs in Japan.

- February 1985—IBM introduced the 3090 new high-end mainframe computers also known as the Sierra line.

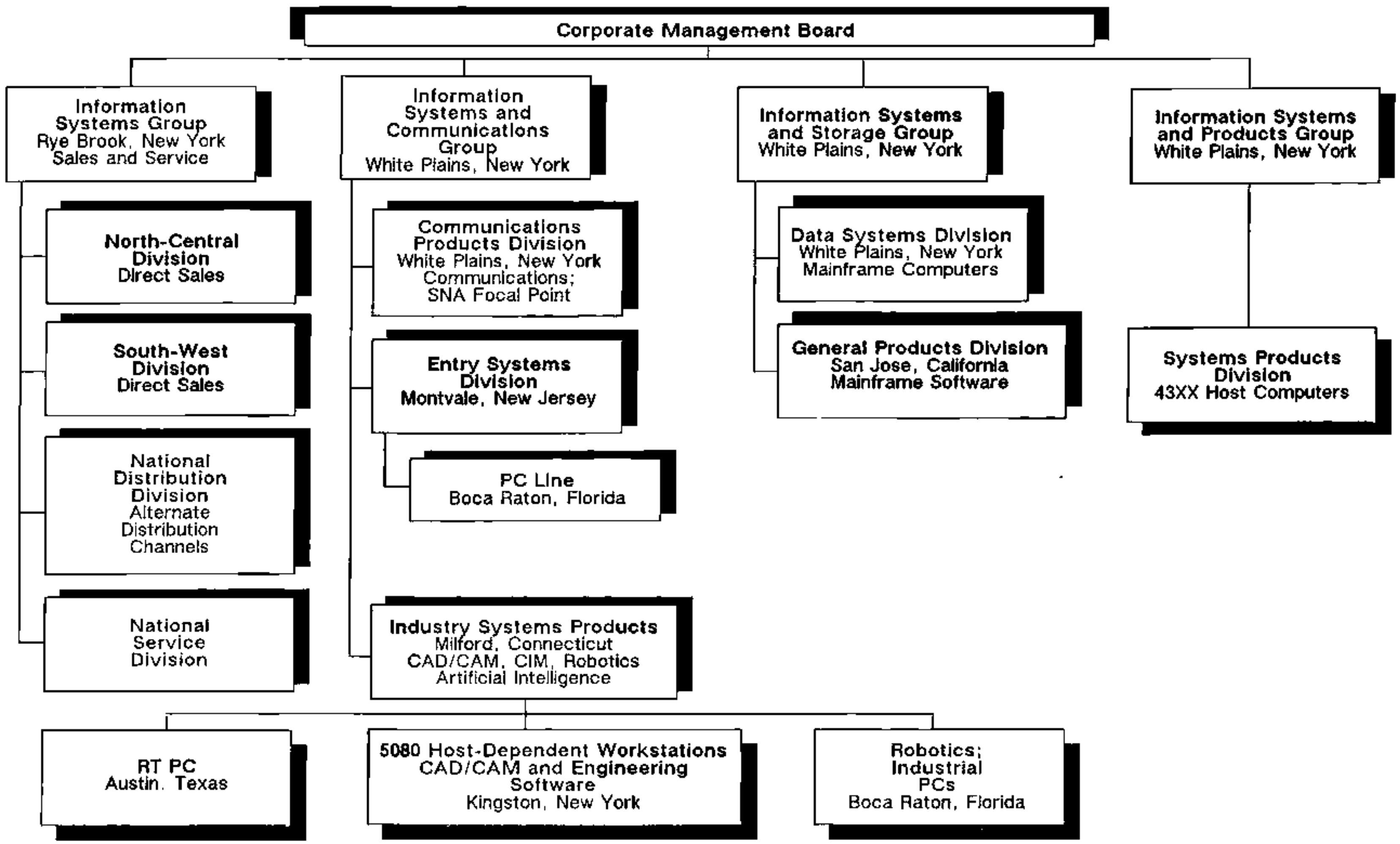
ORGANIZATION

CAD/CAM Operations

The Company's CAD/CAM organizational structure is depicted in Figure 2. Organizations called Independent Business Units have been created to address areas identified as high-potential growth areas. These units are given the authority and the resources to shorten the time required to bring new products to market. Industry Systems Products (ISP) shown in Figure 2 is an Independent Business Unit. ISP is responsible for IBM's computer integrated manufacturing (CIM) strategy, which IBM defines as embracing CAD/CAM, production control, and plant floor automation.

Figure 2

IBM Corporation
Organizational Structure
for Selected U.S. CAD-Related Products



Source: IBM Corporation
Dataquest
August 1986

Facilities

During the period 1981 through 1985, the Company invested more than $20 billion in what it identified as "buildings, land, machinery, and equipment." This investment has focused on automating IBM facilities. Plant automation is a key part of IBM's goal to be the low-cost producer in its markets.

Table 1 shows that IBM's expenditures for land, buildings, and equipment increased significantly between 1981 and 1985, at a 28.6 percent CAGR. During this time, however, manufacturing floor space increased at only a 10.0 percent CAGR, and employees have been added at a 3.4 percent CAGR. Much of IBM's plant and equipment investment has been directed toward automated plants designed for high-volume low-cost production. Automated plants in operation include the Charlotte, North Carolina, plant that manufactures printers and copiers; the Austin, Texas, plant that assembles the RT PC and Personal Computer Convertible; and the Raleigh, North Carolina, plant that builds 3270 family displays.

Table 1

IBM Corporation
Facilities
1981 Versus 1985

	1981	1985	CAGR
Plant, Land, Machinery and Equipment Expenses (millions of dollars)	$ 2,235	$ 6,117	28.6%
Manufacturing and Development Floor Space (millions of square feet)	65.0	95.1	10.0%
Number of Employees (thousands)	354.9	405.5	3.4%
Revenue (millions of dollars)	$29,070	$50,056	14.6%

Source: IBM Corporation
Dataquest
August 1986

MARKETING AND SALES

Hardware Strategy

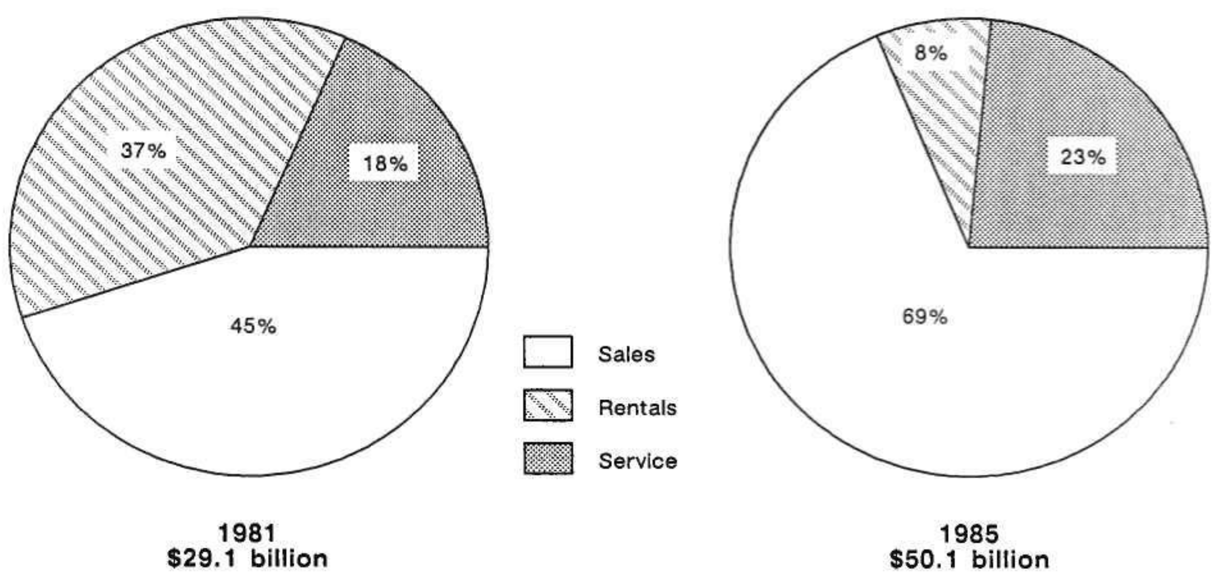
Dataquest believes that IBM's long-range marketing strategy is to make its hardware the industry standard for CAD/CAM applications. The Company's strategy is focused on three platforms: mainframe hosts, the RT PC, and the PC AT. IBM's size and considerable experience in establishing computer standards provide it with important tools for reaching its CAD/CAM goals. Historically, IBM has been the only computer company that has repeatedly established industry standards to which other vendors find they must adapt their products. At present, the Company has established itself as the leading vendor, and has signed reseller agreements with leading CAD/CAM system vendors.

IBM's CAD/CAM strategy is best understood within the context of Company-wide trends. In recent years, IBM has shifted away from rentals and toward the sale of its products, as shown in Figure 3. Previously, as the owner of much of its installed equipment, the Company's interests were best served by maintaining a line of equipment that changed slowly. IBM's present emphasis on sales has paralleled the Company's increasing diversity of product offerings.

Complementing IBM's shift from leasing toward sales is the Company's growing participation in financing products purchased by its customers. In 1985, customers financed approximately $5 billion of IBM equipment through such subsidiaries as the IBM Credit Corporation.

Figure 3

IBM Corporation
Revenue Sources
1981 Versus 1985



Source: IBM Corporation
Dataquest
August 1986

IBM's CAD/CAM strategy is complicated by the fact that the Company is committed to a wide variety of products that were not designed to be compatible. Significant resources are devoted to forging increased compatibility among the Company's own hardware and software products.

Software Strategy

IBM has relied heavily on third-party vendors for its CAD/CAM applications software. Dataquest believes the Company will continue this policy; we expect to see additional third-party CAD applications software from IBM in the future. IBM's CAD/CAM software strategy is depicted in Figure 4. The Company can be expected to focus its own CAD software development efforts on complementing CAD applications with data services and user services. Data services cover such capabilities as file translation and data consolidation. User services provide interfaces between CAD applications software and IBM hardware, including peripheral devices.

IBM has extended its commitment to CADAM and CAEDS software by obtaining versions for the RT PC. A U.S. version of CADAM for the PC was announced in June 1986. While the Company both sells and uses CADAM, CATIA, and CAEDS for mechanical applications, Dataquest believes that the Company sells IC and PCB software that is less sophisticated than many of the software tools it uses internally. For example, although IBM's own integrated circuits and printed circuit boards are designed using state-of-the-art software, the Company does not currently offer software for IC layout.

Distribution

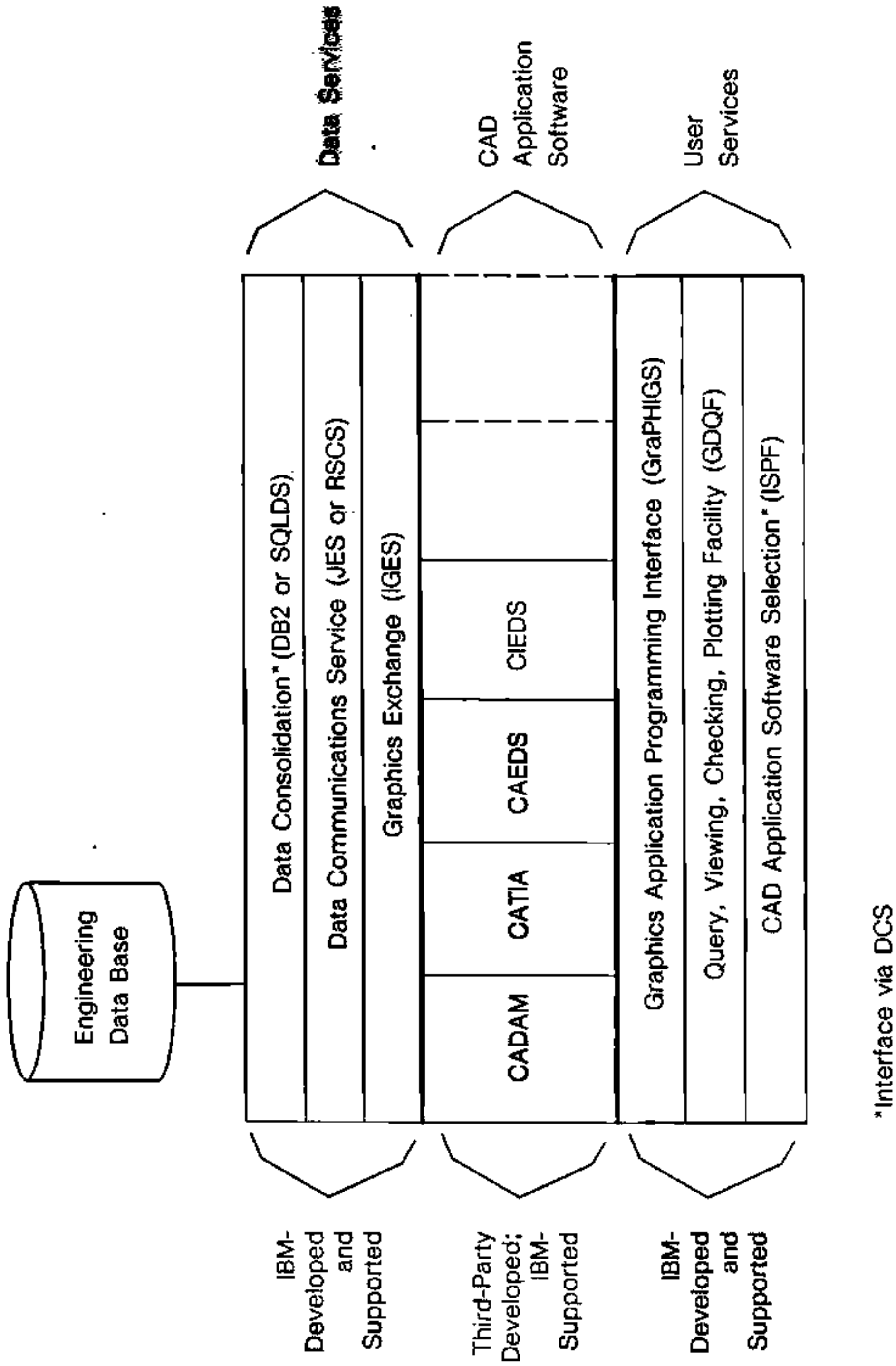
Most CAD/CAM products are sold through IBM's worldwide direct marketing organization. The Company has established more than 20 U.S. Application Marketing Centers that demonstrate and market CAD/CAM products. Programs at these centers are supplemented at the major CAD/CAM Support Centers in Chicago, Poughkeepsie, and Los Angeles. Through the National Distribution Division, the Company authorizes:

- Value-Added Dealers (VADs), who bundle an IBM-approved CAD application package with a PC or RT PC and provide warranty service

- Authorized Dealers, who sell and service a PC or RT PC and may also sell unbundled third-party CAD software

- Value-Added Resellers (VARs), who bundle IBM systems hardware, such as the 4300 line, with proprietary software (these resellers rely on IBM for hardware service).

Figure 4
IBM Corporation
CAD/CAM Software Strategy



Source: IBM Corporation
Dataquest
August 1986

Examples of IBM VARs include Computervision, Matra Datavision, and McDonnell Douglas. The Company has signed VAD agreements with such vendors as Calma, Computervision, Daisy, Futurenet, and Valid Logic. However, many other vendors sell CAD software that runs on the IBM PC, and several of these vendors have VAD agreements with IBM in process.

In addition, the Company supports marketing efforts of third-party vendors through two additional programs:

- A Developers Support Program, administered through ISP, provides selected software developers with discounts and education for the RT PC. The Company publishes a catalog of software developed under this program.
- An Industry Marketing Assistance Program, administered through IBM's direct marketing organization, allows selected organizations with specialized CAD expertise to sell IBM products on a commission basis.

SALES SUPPORT

Warranties

IBM offers a one-year warranty on RT PC products. The 5080 host-dependent workstation system products are warranted for periods from three months to one year.

Maintenance Agreements

The Company's National Service Division is responsible for the Company's extensive maintenance network. A variety of maintenance agreements are available for CAD/CAM products, including hourly service.

Training

IBM offers a wide variety of training programs. The Company's technical assistance for questions on installation and use varies by product. For example, designated users of RT PC products may access the IBM ASKINFO electronic support system.

Application Support

The Company provides Application Transfer Studies to assist in cost justification, Engineering Design Teams to engineer a solution, and Executive Briefings to discuss technological and management issues for computer-integrated manufacturing applications.

STRATEGIC ALLIANCES

Many of IBM's strategic alliances have focused on the telecommunications industry, and include the purchase of Rolm Corporation, joint ownership of International MarketNet with Merrill Lynch & Co., and alliances with MCI Communications and Nippon Telegraph and Telephone. These agreements have been spurred both by openings in telecommunications markets following AT&T's deregulation and by a demand to connect installed hardware manufactured by different vendors.

The Company's CAD/CAM and CIM-related alliances are described below.

Joint Developments

In January 1986, IBM and Industrial Networking Inc. (INI) revealed an agreement to develop jointly Manufacturing Automation Protocol (MAP) products. INI, a joint venture between General Electric and Ungermann-Bass, manufactures MAP-compatible interface products.

Also in January 1986, IBM and Measurex announced an agreement to analyze requirements for implementing computer-integrated manufacturing software on IBM computers.

In September 1985, IBM Italy and the ELSAG-Stet Group formed a joint-venture company called SEIAF. The joint venture will market products for flexible and integrated automation of manufacturing processes.

Reseller Agreements

IBM markets CAD applications software from several third-party vendors, including CADAM from Lockheed, CATIA from Dassault Systems, CAEDS from Structural Dynamics Research Corporation, CBDS from Bell Northern, and CIEDS from Silvar-Lisco. The Company also remarkets Uniras mapping software for the RT PC.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- November 1983—IBM introduced the 5080 color raster host-dependent workstation. The 5080 is compatible with the 3250 vector-refresh model, and supports CADAM, CATIA, CAEDS, and CBDS (Circuit Board Design System) CAD/CAM applications software.

- July 1983—IBM announced the first host computer-based mapping product, the Graphics Program Generator (GPG).

- June 1983—The Company introduced Graphical Display and Query Facility (GDQF) and Initial Graphics Exchange Standard (IGES) software.
- 1983—IBM introduced the 4361 and 4381, two new models of the 4300 series computers targeted for engineering applications.
- 1981—The Company announced that it would market three third-party CAD/CAM software packages: CATIA from Dassault Systems of France, CAEDS from Structural Dynamics Research Corporation, and CBDS from Bell Northern.
- 1977—IBM announced the Model 3250, a host-dependent CAD/CAM workstation using vector-refresh technology. The 3250 replaced the Model 2250.
- 1977—The Company signed an agreement with Lockheed Corporation to market Lockheed's CADAM mechanical CAD software.
- 1973—The Company announced the APT machine tool language for host computers.
- 1964—IBM introduced its first CAD/CAM product, the Model 2250, a host-dependent workstation.

CAD/CAM PRODUCTS

Market Segment Participation

IBM supplies turnkey systems for AEC, EDA, mapping, mechanical, and PCB applications. The Company also sells OEM computers and OEM graphics hardware.

Product Line

The Company's products are shown in Table 2.

Table 2

IBM Corporation
CAD/CAM Products

HOST COMPUTERS

Model	Description
System/370, 43XX, 308X, 309X	Principal host computers used in conjunction with IBM's CAD/CAM applications software and host-dependent workstations.

HOST-DEPENDENT WORKSTATIONS

Model	Description
5080	Raster display system with up to 256 displayable colors and 1024 x 1024 resolution

STANDALONE WORKSTATIONS

Model	Micro-processor	Word Size	Maximum Resolution	Number of Colors	Comment
RT PC	IBM RISC	32	720 x 512 color; 1,024 x 768 mono	16	Can be used with 5080 Graphics System for 1,024 x 1,024 resolution

PERSONAL COMPUTER-BASED WORKSTATIONS

Model	Micro-processor	Word Size	Maximum Resolution	Number of Colors	Comment
PC AT /G, /GX	80286	16	1,024 x 1,024	16	Distributed primarily through resellers for CAD applications

(Continued)

Table 2 (Continued)

IBM Corporation
CAD/CAM Products

APPLICATION SOFTWARE

Name	Platform	Description
CADAM (Computer-Graphics Augmented Design and Manufacturing)	Host computer	General-purpose 2-1/2D or 3D design and drafting system that includes design, analysis, drafting, tool design, and NC part programming functions; Design/Build/Manage module is directed toward architects and facilities managers
Professional CADAM	RT PC	2-1/2D version of CADAM
Micro CADAM	PC AT	2-1/2D subset of CADAM
CATIA (Computer-Aided Three-Dimensional Interactive Applications)	Host computer	3D geometry system for solids modeling and complex surface design; includes kinematics analysis and generation of NC tapes for manufacturing production; provides modules for 2D building design and robotics simulation and programming
CAEDS (Computer Aided Engineering Design System)	Host computer, RT PC	Engineering analysis system that provides capabilities for pre- and post-processing, frame analysis, and finite element analysis; Systems Analysis module is used for design of complex mechanical systems and provides solids modeling, modal analysis, and assembly of solid components

(Continued)

Table 2 (Continued)

IBM Corporation
CAD/CAM Products

APPLICATION SOFTWARE (Continued)

Name	Platform	Description
CBDS 2 (Circuit Board Design System 2)	Host computer	Printed circuit board design system; Circuit Pack module includes schematic capture, layout, and libraries; Design Verification option provides logic simulation and test pattern generation
CIEDS (Computer-Integrated Electrical Design Series)/ Design Capture	Host computer, RT PC, PC AT	Design entry with schematic capture and netlist extraction for external simulators

DATA SERVICES/USER SERVICES SOFTWARE:

Name	Platform	Description
GraPHIGS (Programmer's Interactive Graphics System)	Host computer, RT PC	Implementation of PHIGS, an ANSI-proposed standard hierarchical for device-independent programming of 3D graphics
IGES (Initial Graphics Exchange Standard)	Host computer	Translates data from CAD application software to the IGES ANSI standard
DCS (Data Communications Service)	Host computer	Merges data from different CAD applications from networked IBM computers into a consolidated design file; uses IBM DB2 relational data base
GDQF (Graphical Display and Query Facility)	Host computer	"Read only" viewing of CAD design models on 3270 display terminals; typical applications include factory floor viewing

Source: IBM Corporation
Dataquest
August 1986

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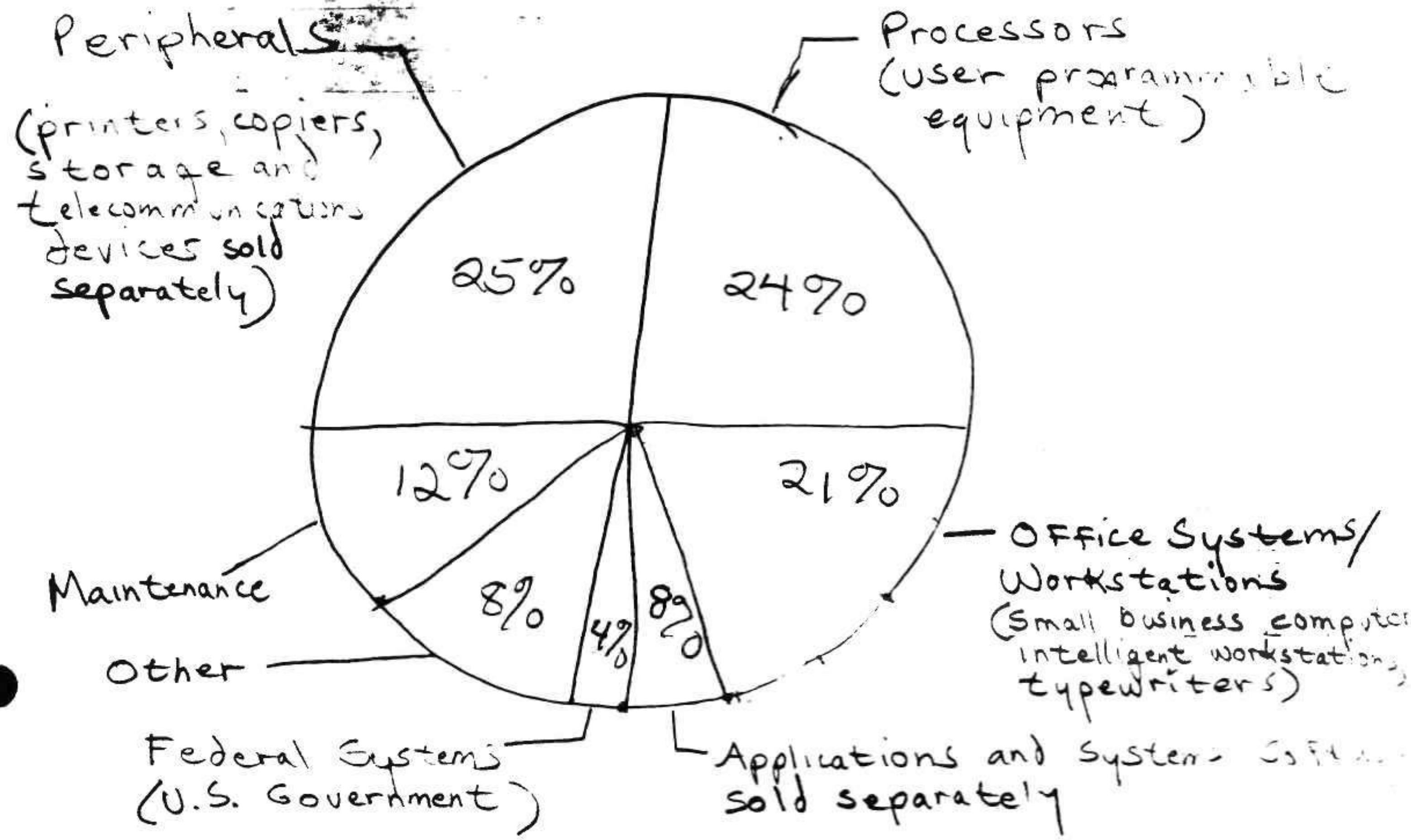
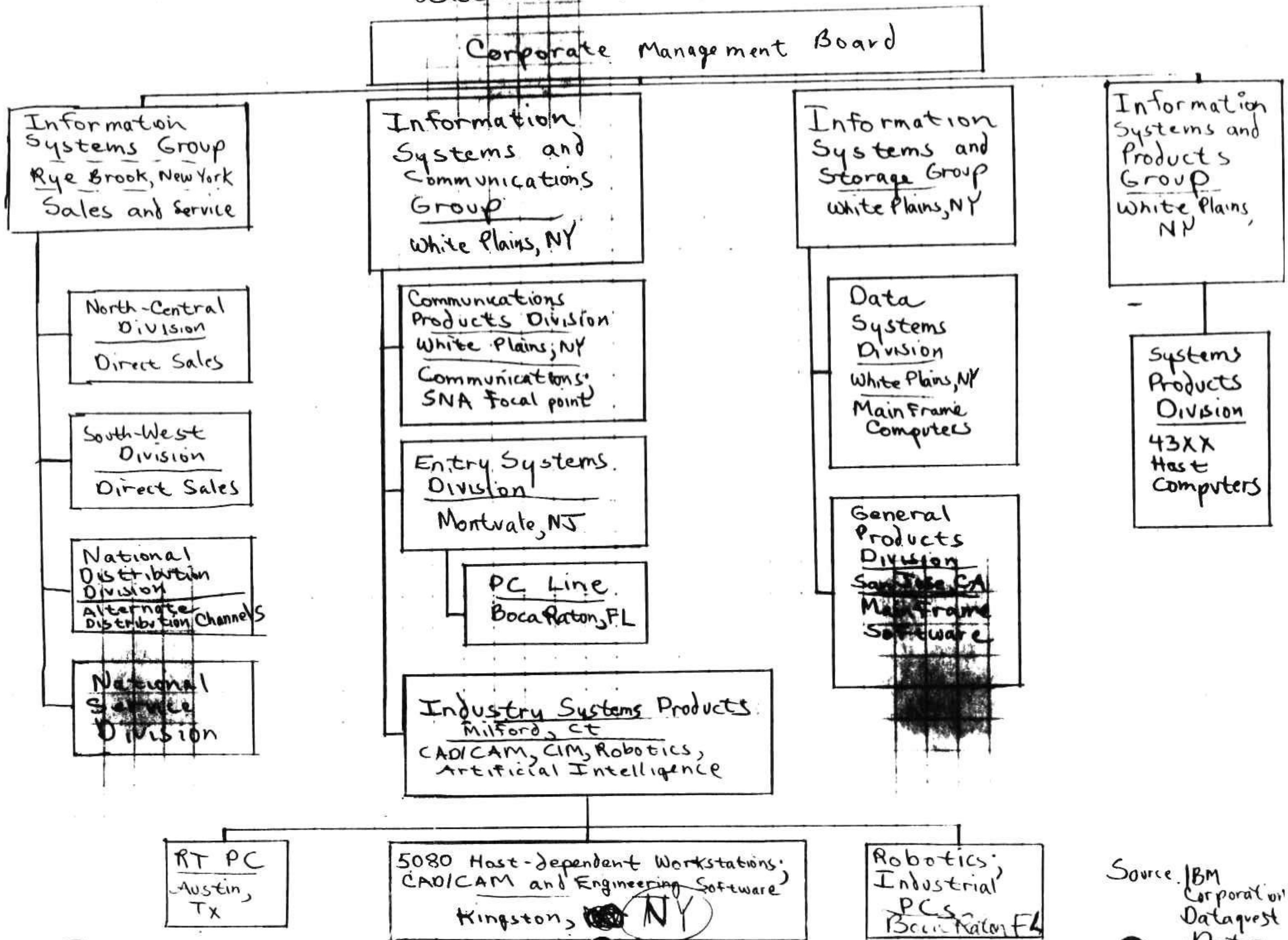
Figure 1. IBM Corpor... 1985 Revenue by Product Cl...



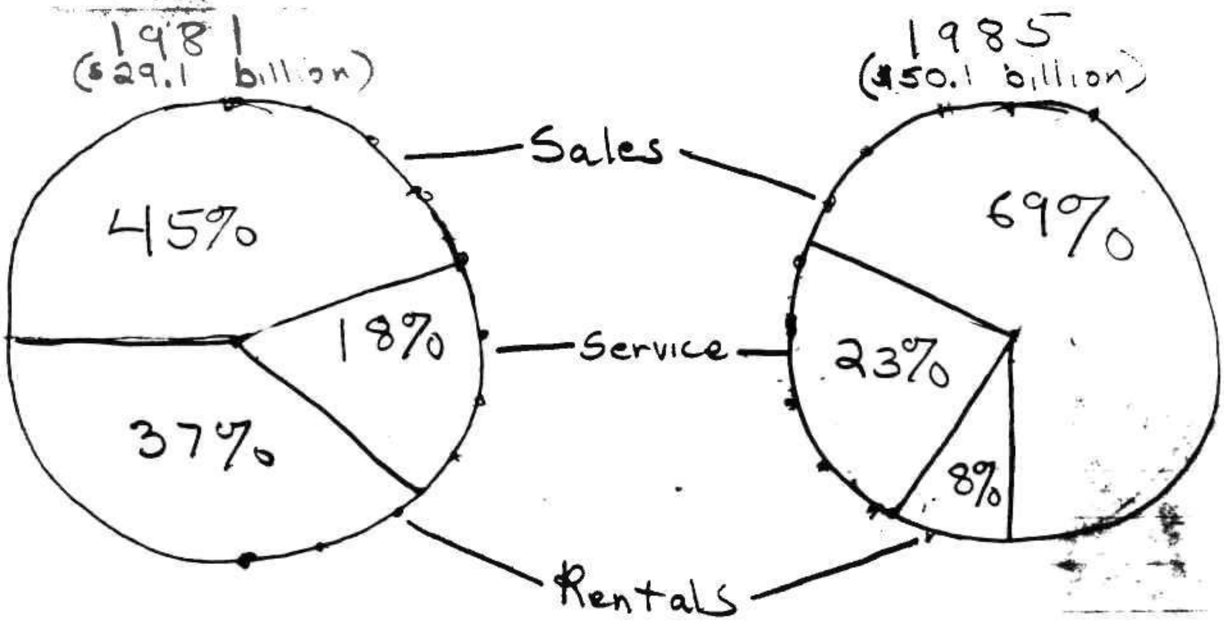
Source: IBM Corpor... Data

Figure 2. IBM Organizational structure for Selected U.S. Cad-related Products.



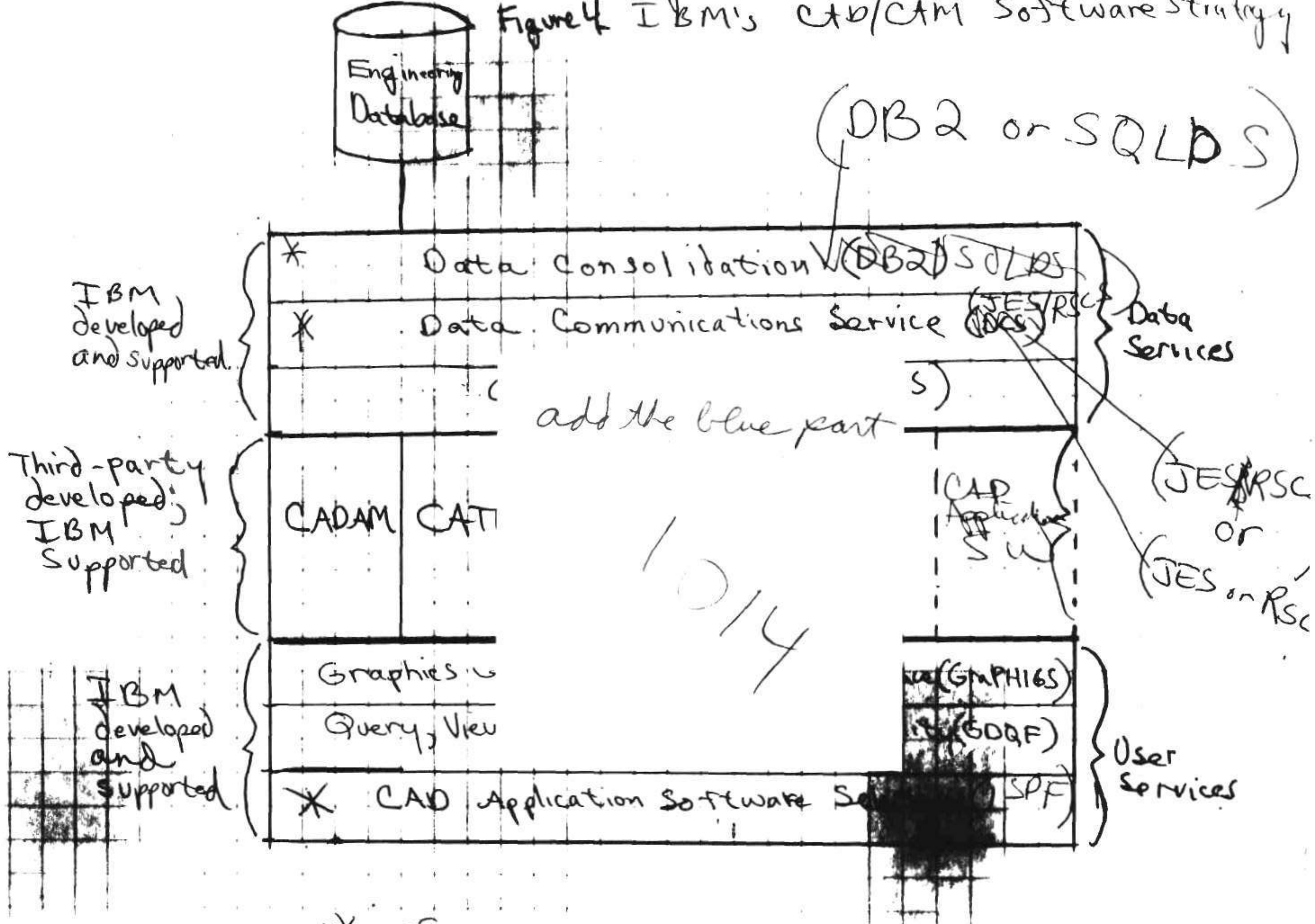
Source: IBM Corporation
Dataquest
Date

Figure 3. IBM Revenue Sources 1981 versus 1985



Source: IBM Corporate Date

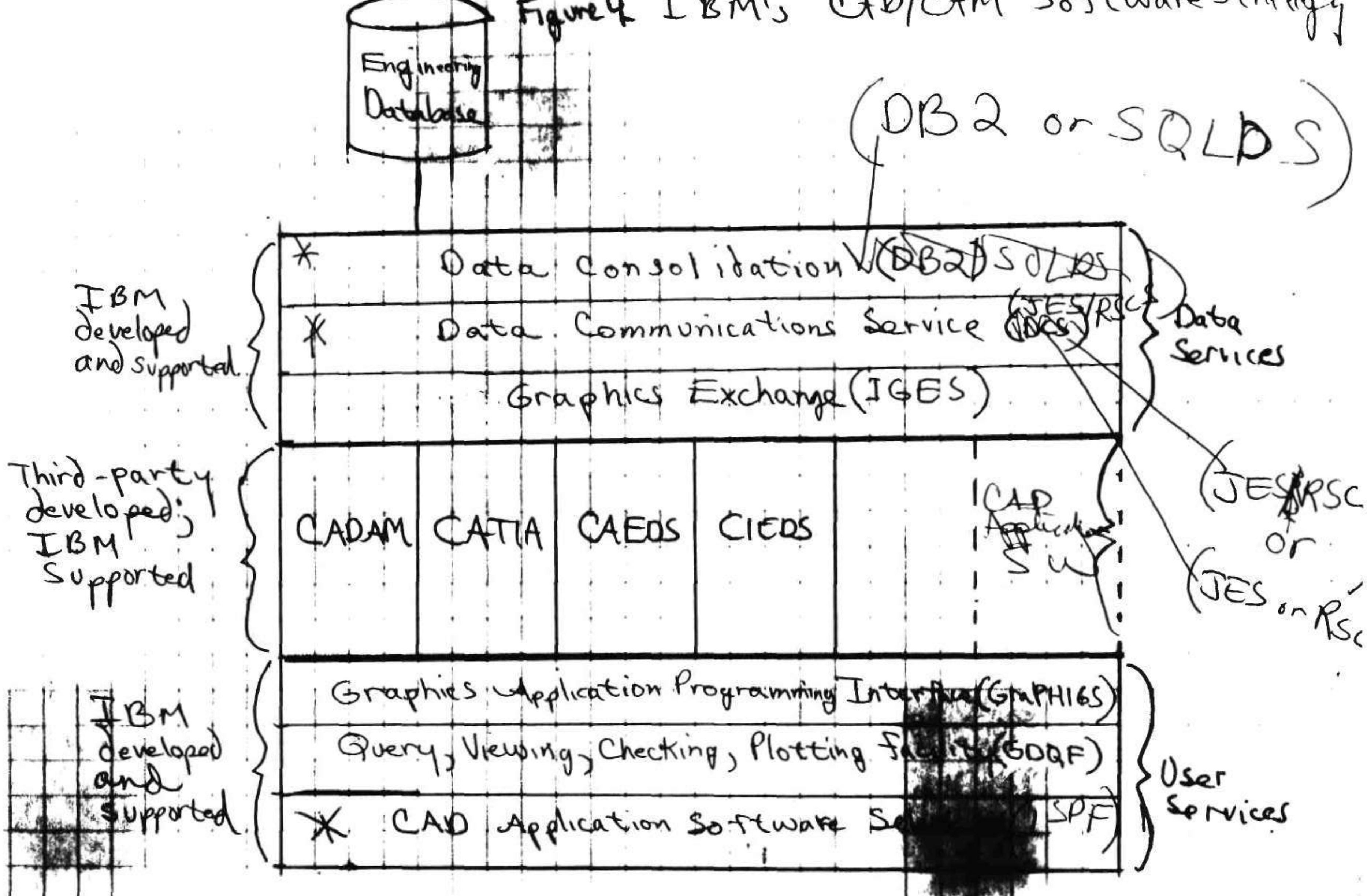
Figure 4 IBM's CAD/CAM Software Strategy



*interface via DCS.

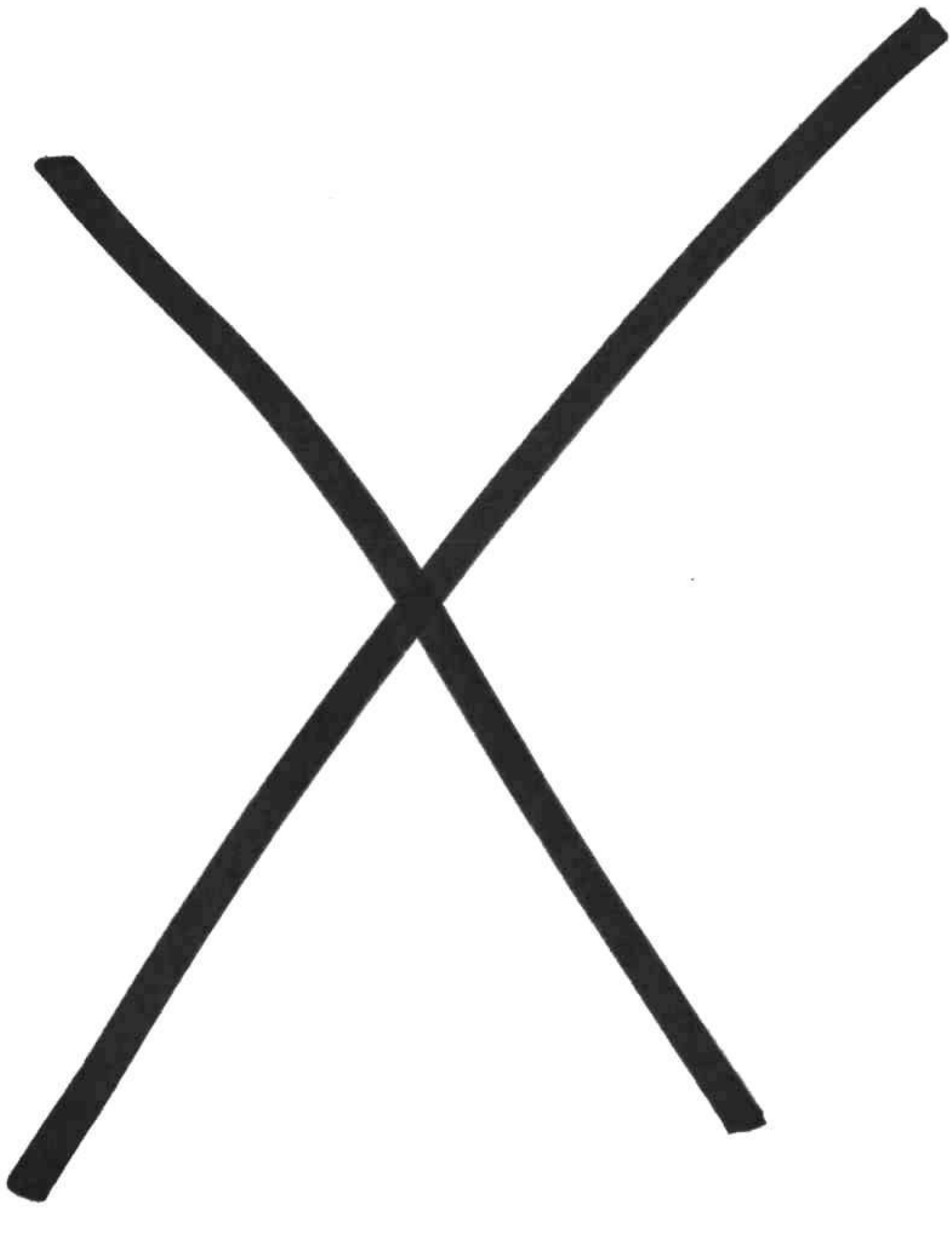
Source: IBM Corporation
Dataquest
Pale.

Figure 4 IBM's CAD/CAM Software Strategy



*interface via DCS.

Source: IBM Corporation
Dataquest
Pate.



Lexidata Corporation

Lexidata Corporation
755 Middlesex Turnpike
Billerica, Massachusetts 01865
Telephone: (617) 663-8550 TWX: 710-347-1574
(Thousands of Dollars Except Per Share Data)

Balance Sheet (September 30)

	1979	1980	1981	1982	1983
Working Capital	$ 149	$ 445	$ 3,333	$19,234	$18,778
Long-Term Debt	$ 33	$ 251	$ 341	$ 457	$ 550
Shareholders' Equity	$ 265	$ 809	$ 4,067	$22,459	$22,513
After-Tax Return on Average Equity (%)	47.4	(59.7)	84.2	23.6	(3.0)

Operating Performance (Fiscal Year Ending September 30)

	1979	1980	1981	1982	1983
Revenue	$1,925	$4,440	$14,529	$28,562	$25,689
Cost of Revenue	$ 856	$2,433	$ 6,142	$13,364	$14,858
R&D Expense	$ 342	$ 882	$ 1,657	$ 4,497	$ 4,607
SG&A Expense	$ 602	$1,399	$ 3,261	$ 7,205	$ 7,638
Pretax Income	$ 91	$ (321)	$ 1,904	$ 4,623	$(1,047)
Pretax Margin (%)	4.7	(7.2)	13.1	16.2	(4.1)
Effective Tax Rate (%)	14.1	N/A	44.5	46.0	46.0
Net Income	$ 101	$ (321)	$ 2,053	$ 3,134*	$ (182)*
Average Shares Outstanding (Millions)	1,740	2,997	4,116	5,405	5,627
Per Share					
Earnings	$ 0.06	$(0.11)	$ 0.50	$ 0.58	$ (0.03)
Book Value	N/A	N/A	0.95	$ 4.15	$ 4.00
Price Range	N/A	N/A	N/A	$ 6 1/4-14 1/8	$ 7 7/8-13 1/2
Total Employees	N/A	87	239	445	357

N/A = Not Available

*Includes credit for income taxes of $1,489,100 in 1982 and $865,400 in 1983

Source: Lexidata Corporation
Annual Reports and Forms 10-K
DATAQUEST

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Lexidata Corporation

THE COMPANY

Background

Lexidata Corporation was incorporated in 1974 in Massachusetts. The Company designs, manufactures, markets, and services a family of medium- to high-speed, medium- to high-resolution raster graphics display processors and subsystems used in interactive computer graphics and imaging systems. The products are used for applications ranging from computer-aided design/computer-aided manufacturing (CAD/CAM) to graphic arts, business graphics, military command and control, and mapping, simulation, medical, and scientific imaging.

Operations

Lexidata's products are sold primarily to original equipment manufacturers (OEMs) and to sophisticated end users such as industrial manufacturers, governmental agencies, and universities, which incorporate these components into application-oriented systems. In the fiscal year ending September 30, 1983, sales to OEM customers accounted for approximately 77 percent of total revenues, with sales to the Company's five largest customers accounting for approximately 56 percent of total revenues. The largest customer, Calma Company, a wholly owned subsidiary of General Electric Company (GE) accounted for 28 percent of sales. Other operating units of GE accounted for an additional 2 percent of sales in fiscal 1983.

Labor costs decreased during 1983 to approximately 10 percent of the Company's manufacturing costs. The Company attributes this reduction in labor costs to expanded use of automation and improvements in product design.

International Operations

Lexidata Ltd., a wholly owned subsidiary in the United Kingdom, provides sales and technical support for Lexidata's European operations. The Company has distributor agreements in Australia, Israel, The Netherlands, Switzerland, and West Germany, and uses a combination of direct sales and distributor agreements in France and Japan.

Lexidata Corporation

Marketing, Sales, and Customer Support

Lexidata's display processors function as an information interface between the computer and the operator and generate color, gray scale, or monochrome representations of engineering designs and drawings, photographs and artwork, and business graphics.

Lexidata traditionally has concentrated on the high-performance segment of the computer graphics industry. The Company's current customer base is composed mostly of OEMs that incorporate Lexidata's display processors into computer-aided design (CAD) systems. Approximately 80 percent of the Company's business was derived from CAD/CAM applications during fiscal 1983.

In the United States, the Company markets its display processors through a direct sales staff. In fiscal 1983, the Company employed 14 salespersons located at 10 sales offices. Customer technical support is provided by systems engineers located at the Company's corporate offices and at four of its sales offices. Technical support is provided to international customers through the Company's distributors and the Company's personnel in Japan, the United Kingdom, and France. As of September 30, 1983, the Company had 68 employees engaged in marketing, sales, and sales support activities.

Research and Development

In fiscal 1983, Lexidata invested approximately $4.6 million, or 17.9 percent of revenues, in research and development. Several new products were announced in 1983, including IMAGEVIEW, a low-cost imaging subsystem, and GEOVIEW, a seismic data analysis subsystem.

Organization

In October 1983, Andrew C. Knowles was named President, Chief Executive Officer, and a Director of the Company, replacing Ralph T. Linsalata. Lexidata's principal administrative and manufacturing operations are located in Billerica, Massachusetts. The Company occupies approximately 121,000 square feet of leased space. In addition, the Company has options to lease two additional 60,000-square-foot facilities to be built adjacent to the present leased facilities.

As of September 30, 1983, Lexidata employed 357 persons. Approximately 326 employees are located in Billerica, Massachusetts, and the remainder are located in the Company's 13 sales offices in the United States, the United Kingdom, France, and Japan.

Lexidata Corporation

LINES OF BUSINESS

Lexidata's principal products include the following:

- System 2000--a family of intelligent, high-performance graphics terminals designed for OEMs and end-users. Based on Motorola 68000 microprocessors, these systems are available in monochrome or color.

- System 3000--a family of compatible, high-speed, high-performance raster graphics display processors. The newest member, the model 3700, features 1280 x 1024 resolution, 60Hz noninterlaced refresh rate, color, and block-mode writing speeds of up to 42 million pixels per second.

- System 8000--a family of distributed graphics processing systems featuring dual processor architecture. The model 8100/GS, developed primarily for CAD/CAM applications, is packaged in standard configurations that offer a choice of resolution, number of memory planes, refresh rate, and monitor performance levels.

- SOLIDVIEW--a solid modeling system with local hidden surface removal and local visible surface shading capabilities. SOLIDVIEW is offered in packaged systems that combine hardware and firmware configured for generation of shaded solid images. Two versions are available, the 345V-1, a low-cost, display-only system, and the 345V-2, which provides the same power as the 345V-1 and also includes pan/zoom, four overlays, hardware cursor, and serial interfaces.

- IMAGEVIEW--a flexible subsystem for imaging applications designed to off-load the host computer for processing, manipulating, and displaying image and pixel data.

- GEOVIEW--a seismic display processor that combines image processing, two-dimensional graphics, and solid modeling capabilities for the interpretation of seismic data.

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LSI Logic Corporation

LSI Logic Corporation
1601 McCarthy Boulevard
Milpitas, California 95035
Telephone: (408) 263-9494 Telex: 172153
(Millions of Dollars Except Per Share Data)

Balance Sheet (December 31)

	1981	1982	First Quarter 1983
Working Capital	$ 0.04	$ 7.06	$ 8.95
Long-Term Debt	$ 2.19	$ 5.42	$ 5.84
Shareholders' Equity	$ 4.06	$ 9.93	$12.64
After-Tax Return on Average Equity (%)	N/A	N/A	9.6

Operating Performance (Fiscal Year Ending December 31)

	1980	1981	First Quarter 1983
Revenue	$ -	$ 4.97	$ 5.09
U.S. Revenue	$ -	$ 4.22	$ 4.33
Non-U.S. Revenue	$ -	$ 0.75	$ 0.76
Cost of Revenue	$ -	$ 4.32	$ 2.42
R&D Expense	$ 0.84	$ 2.27	$ 0.65
SG&A Expense	$ 1.87	$ 2.71	$ 0.75
Pretax Income (Loss)	$(1.96)	$(3.74)	$ 1.19
Pretax Margin (%)	N/A	N/A	23
Effective Tax Rate (%)	N/A	N/A	8
Net Income (Loss)	$(1.96)	$(3.74)	$ 1.08*
Average Shares Outstanding (Millions)	4.41	5.08	17.52**
Per Share			
Earnings (Loss)	$(0.74)	$(0.20)	$ 0.06*
Dividend	$ 0.00	$ 0.00	$ 0.00
Book Value	$ 0.91	$ 1.95	$ 0.72
Price Range	$ N/A	$ N/A	$ 15-20
Total Employees	N/A	100	127

N/A = Not Available
*Includes extraordinary credit of $320,000 or $0.02 per share
**The Company's stock was offered publicly in May 1982, with 5,000,000 shares being offered at $15 per share.

Source: LSI Logic Corporation Prospectus
DATAQUEST

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LSI Logic Corporation

THE COMPANY

Background

LSI Logic Corporation designs and manufactures a variety of semi-custom gate array logic circuits. The Company was incorporated in June 1980 and first shipments of products began in early 1982. Gate array circuits are primarily very large scale integrated circuits and feature CMOS, HCMOS, and ECL technologies. LSI Logic Corporation falls under the DATAQUEST category of Application-Specific Integrated Circuit (ASIC) vendors.

LSI Logic believes a good market exists for custom and semicustom circuits, since electronic systems manufacturers are continually seeking to improve the performance and reliability of their products, while at the same time reducing costs and maintaining control of proprietary features of their products. LSI Logic Corporation enables these companies to accomplish these goals, reducing design cycle time for semicustom and custom circuitry to an acceptable level by providing its clients access to such advances as structured circuit design methodology, computer-aided design and manufacturing, and uncommitted gate array circuits.

LSI Logic allows its customers to participate to any extent they wish in the design and manufacture of various semicustom circuits. A customer may submit only a logic diagram and the Company will then complete the design and production of prototype circuits. The customer may become further involved by participating in the process of analyzing the logic diagram, simulating the logic of the circuit, and helping to complete the production of the package. In this case, the customer's engineer uses the LDS-II system, either at LSI Logic's facility or through time-sharing. If the client company elects a timesharing approach, it may purchase an LDS-II gate array design workstation. Finally, a client company may license all of the LDS-II software and run the programs on its own computers. This alternative is generally cost effective when a large number of gate arrays are being designed concurrently. The customer then, in this case, exercises greater control over timing of the design programs and the resources applied to implementing the rapid design of logic circuits.

Gate array circuitry technology is based on the concept of a matrix of uncommitted logic functions contained on a single chip of silicon. The gate array remains uncommitted through most of the complex processing cycle and is programmed, or customized, only in the last steps of the manufacturing process. Such circuits range in size from 300 to 10,000 gates. They are mass produced in a variety of sizes and held in inventory, by the Company, for customization at a later time.

LSI Logic Corporation

It should be noted that gate arrays provide the system manufacturer with an option that is lower in cost, more reliable, and that consumes less power than standard logic circuits. However, when compared to other semicustom circuits such as standard cells, gate arrays use more real estate on the chip.

Operations

The Company derives revenue from the sale of manufactured components or circuits, and from design products and services. The revenue derived from the sale of design products and services was 2.5 times that derived from component sales in 1982. This gap narrowed slightly for the first quarter of 1983, reflecting a pattern followed by many start-up companies. Company management anticipates that as production and component sales increase, design products and services revenue will decrease to a level well below 50 percent of total revenue. It is interesting to note, however, that the revenues derived from design products and services for the year 1983 (if extrapolated based on first quarter performance), will make LSI Logic one of the top three suppliers of turnkey IC design-automation products. Design products and services account for 71 percent of the Company's total revenue, with component sales providing 29 percent. Of total revenues, approximately 15 percent are derived in Western Europe.

Marketing

LSI Logic has focused its marketing efforts on a broad base of manufacturers of electronic data processing systems, military and aerospace systems, telecommunication products, and manufacturers of selected automotive, consumer, industrial, instrumentation, and medical products. Initial customers of the Company have been primarily manufacturers of computer peripherals, such as Xebec, Seagate Technology, and Shugart Associates. The second most prominent group of customers have been manufacturers of computer systems, including Burroughs, Convergent Technologies, Digital Equipment, IBM, RCA, and Wang Laboratories.

It is essential for a company such as LSI Logic to develop a close working relationship with its customers and their engineers. LSI Logic views the LDS-II system as a tool that enables design support and training services to be provided in a cost-effective fashion to the customer.

Typically, a customer's design engineers attend a training class at the Company's design centers and, once trained, begin to use the LDS-II.

LSI Logic Corporation

LSI Logic's design centers are located in Milpitas, California, and Boston, Massachusetts. Additional expansion is anticipated in Los Angeles, California; Dallas, Texas; Minneapolis, Minnesota; London, England; Munich, Germany; and Tokyo, Japan.

In addition to providing design products and services, LSI Logic, as a manufacturer of integrated circuits, has entered into various second-source licensing agreements. These agreements give the licensees nonexclusive rights to use and market the Company's gate array design and production technology, which then allows the licensees to compete with LSI Logic. This kind of competition is a reflection of standard practice in the electronics industry, in which sole-source suppliers of electronic components are virtually nonexistent. LSI Logic receives a royalty based on revenues from component sales by its second-source licensees.

LSI Logic markets its products and services in the United States through 21 independent sales representatives who work closely with the Company's marketing and sales organization. The marketing and sales organization currently consists of 10 persons. The Company also maintains direct sales offices in Boston, Minneapolis, and Milpitas. For foreign sales the Company maintains relationships with eight independent sales representatives and also has a direct sales office in London, England. Independent representatives are compensated on a commission basis, considering the sales of all products and services.

Research and Development

It is extremely important for a company such as LSI Logic to maintain a strong investment program in research and development. LSI Logic's financial records indicate that in 1983 the Company will spend approximately 13 percent of total revenues on R&D. This is down substantially from nearly 45 percent of total revenues in 1982. However, 1981 was essentially a start-up year for the firm. R&D expenditures are split among several areas:

- Design of new products
- Improvement of process technologies
- Enhancement of the various CAD software modules
- Cost reduction of existing products

Projects that are currently under development include:

- Efforts to improve the Company's fine-line multilevel metallization capability

LSI Logic Corporation

- Development of tape-automated bonding technology
- Development of advanced techniques for prototype manufacturing
- Development of new design-automation tools for simulation programs used in a multicircuit environment
- Performance/enhancement of the current LDS-II software and design workstations
- Development of higher-performance HCMOS and ECL technology array products. Product areas such as linear circuits, digital arrays, and gate arrays with memory functions are among those being considered.

During fiscal years 1981 and 1982, and the three-month period ending March 27, 1983, the Company expended $841,000, $2,272 million, and $647,000, respectively, on R&D activities. R&D commitments for entire fiscal 1983 will fall in the range of 10 to 15 percent of total Company revenues.

Manufacturing

The Company's manufacturing operations are extensive, involving conversion of a customer's design into a packaged prototype silicon chip, and supporting volume production requirements of these chips to meet the customer's needs. Each product the customer buys is based on a master-slice wafer designed by the Company. These wafers are produced by subcontractors that fabricate the wafer to the optical and electrical specifications of the Company. After fabrication, the wafers are maintained in inventory at LSI Logic. Wafers are purchased primarily from Japanese suppliers. Personality wafer fabrication performs the process associated with converting the master-slice wafer into specific custom silicon chips by integrating uniquely designed masking steps onto the master slice. The fabrication operation is located at the Company's Milpitas facility, in 15,000 square feet of clean-room module.

In the next step, the assembly process, the fabricated gate array circuit is encapsulated into ceramic or plastic packages. Plastic packaging is normally associated with lower-cost, commercial applications, whereas ceramic packaging is intended primarily for applications in which the circuit must be protected against harsh operating environments, such as in military applications. All ceramic package assembly is performed by the Company at its Milpitas facility; plastic packaging is subcontracted to independent offshore assembly plants.

Finally, the Company conducts product testing operations at its Milpitas facility. This facilitates rapid prototype and volume production cycle times. The testing process includes wafer probe, final test, and final quality assurance acceptance. Various test programs, running on mainframe computer systems, are used in this comprehensive testing sequence. The test programs use basic functional test criteria from the design simulation program, which was generated or approved by the customer's design engineers.

Organization

As of March 27, 1983, the Company had 127 employees: 13 in marketing and sales, 66 in research development and engineering, 38 in manufacturing, and 10 in executive and administrative capacities. The Company's executive offices and 15,000-square-foot manufacturing plant are located in Milpitas, California; total square footage of the Milpitas facility is 47,500 square feet. A lease on the facility expires in 1991. In addition, the Company leases office space for its remote design centers and direct sales and marketing offices in Milpitas, Minneapolis, Boston, and London. Mr. Wilfred J. Corrigan is President of the Company. Vice President of Sales and Marketing is William J. O'Meara; Vice President of Engineering is Robert M. Walker; Vice President of Finance and Administration is Mitchell Bohn; Vice President of Design Automation is James S. Koford; Vice President of Research & Development is Conrad J. Deloka; and Vice President of Operations is John D. Higby.

CAD/CAM BUSINESS

LSI Logic has developed a wide range of CAD systems that are used in the engineering design of its various gate array products. The Company has found it useful, in fact, to develop sophisticated CAD tools that make the design process easier and generate significant revenues for the Company. The design automation system or complete CAD system is called LDS-II. It is used both by the Company and its customers to define, design, and subsequently obtain prototypes of accurate and fully tested custom gate array circuits. In DATAQUEST's opinion, this particular system is more correctly called an electronics computer-integrated manufacturing (ECIM) system, since it contains design engineering elements in addition to testing, manufacturing, and simulation elements. The LDS-II system allows users to automatically generate interconnection patterns of the logic elements on the gate array, thereby turning the standardized master slice into a semicustom integrated circuit.

LSI Logic Corporation

The LDS-II system operates on IBM-compatible mainframe computers. The system is actually a group of different programs that are interconnected via a data base and libraries. The basic libraries and data bases contain sublibraries of semiconductor macrocells, a technology data base, and a design-automation software program. The program outputs a pattern-generation tape. The system also produces a test tape that interfaces to standard industry testing systems.

In summary, the LDS-II system performs the following functions:

- Circuit simulation, using the SPICE program developed by the University of California

- Automatic logic simulation, using the Techsym system from CGIS

- Design verification, using an internally developed program that ensures all design rules are followed and that analyzes system performance and sizing constraints

- Automatic test-tape generation

- Automated physical design, in which the circuit description is accepted, based on logic simulation and design verification results, and a pattern-generation tape is created

To facilitate ease of use for the customer, LSI Logic has recently offered a single-user design workstation. This workstation incorporates some functions of the Mentor Graphics system but also includes significant value added by LSI Logic. The workstation is based on the Apollo computer, DN400 or DN600, and includes the IDEA series software from Mentor, as well as the complete logic simulation program, timing verification system, and the necessary macrocell libraries and technology data bases from LSI Logic. Input from the workstation can be fed directly to a large IBM-compatible mainframe located at an LSI Logic design center, which then carries out the more complete simulation, pattern generation, and automatic test-tape generation. The large mainframe is used for accurate and reliable automatic routing and placement of components and circuits on the gate array. This process is internally developed by LSI Logic.

Other products available only on the IBM-compatible system are Electric Rule Check (ERC), and Design Rule Check/Manufacturing Rule Check (DRC/MRC), also developed by LSI Logic. In addition, certain products made available by Phoenix Data Systems to LSI Logic can be used in the gate array design.

LSI Logic Corporation

The use of the LDS-II design system has been extensive, with over 250 different designs having been completed on the system. The Company estimates that use of LDS-II will permit the customer to go from concept to finished working prototype in six to ten weeks. It should be stressed that the LDS-II product is really a combination of design automation tools plus actual manufacturing tools. The Company conducts training sessions on the use of the system and estimates that one week is required for the customer to gain sufficient knowledge to use the system.

It is likely that in calendar 1983 the Company will generate in excess of the $15 million of revenues derived from sale of the LDS-II product and associated services. Based on this amount, DATAQUEST estimates that LSI Logic will be the third largest design automation vendor for calendar 1983.

Products

Earlier sections have described in general the product and services of LSI Logic. LSI Logic sells semicustom gate array products. The LSI products are basically broken down into five families. The five families are as follows:

- LC Series--with 300 to 1,780 gates using CMOS technology with one layer of metallization. Typical speed is 6 nanoseconds with between 18 and 92 pins. Typical design geometry is 5 microns.

- LL3000--with 272 to 2,500 gates using HCMOS technology with one layer of metallization. Typical speed is 4 nanoseconds with between 18 and 104 pins. Typical design geometry is 3.5 microns.

- LL5000 family--with 880 to 6,000 gates using HCMOS technology with two layers of metallization. Typical speed is 2.5 nanoseconds with between 28 and 180 pins. Typical design geometry is 3 microns.

- LL7000--with 960 to 10,000 gates using HCMOS technology with two layers of metallization. Typical speed is 1.3 nanoseconds with between 28 and 180 pins. Typical design geometry is 2 microns.

- LCA-ECL--with 600 to 1,200 gates using ECL technology with two layers of metallization. Typical speed is 1 nanosecond with 68 pins. Typical design geometry is 4 microns.

LSI Logic Corporation

The LC series was introduced in 1981 and was licensed by the Company from California Devices. The LCA-ECL product was developed by the Company and introduced in September 1981. The LL5000 series, introduced in September 1981, and the LL7000 series, introduced in February 1983, were developed by the Company in conjunction with Toshiba Corporation. Each company has joint ownership for the base array of these products. The LL3000 series was developed by the Company and introduced in February 1983.

The design engineering and services products are composed of:

- The Mentor/Apollo design workstation
- The LDS-II software libraries and programs
- The use of large IBM-compatible mainframes

THE MACNEAL–SCHWENDLER CORPORATION

The MacNeal-Schwendler Corporation
815 Colorado Boulevard
Los Angeles, California 90041
Telephone: (213) 258-9111 Telex: 4720462
(Millions of Dollars Except Per Share and Employee Data)

Corporate Financial Profile as of January 31

	1982	1983	1984	1985	1986	CAGR 1982-1986
BALANCE SHEET DATA						
Working Capital	$ 2.0	$ 2.7	$ 12.4	$ 14.6	$ 15.7	67.7%
Long-Term Debt	$ 0.1	$ 0.1	$ 0.1	$ 0.1	$ 0.1	1.1%
Shareholders' Equity	$ 2.7	$ 4.0	$ 14.1	$ 19.9	$ 21.3	67.6%
After-Tax Return on Average Equity	61.3%	52.7%	28.0%	18.7%	12.3%	
OPERATING PERFORMANCE						
Revenue	$ 7.2	$ 9.2	$ 11.8	$ 15.3	$ 21.1	30.9%
U.S. Revenue	$ 4.8	$ 5.4	$ 7.7	$ 10.4	$ 14.6	32.0%
Non-U.S. Revenue	$ 2.4	$ 3.8	$ 4.1	$ 4.9	$ 6.5	28.5%
Cost of Goods Sold	$ 1.8	$ 2.4	$ 2.9	$ 3.3	$ 4.4	25.4%
Gross Margin	$ 5.4	$ 6.8	$ 8.9	$ 12.0	$ 16.7	32.5%
Expenses	$ 3.0	$ 3.9	$ 5.1	$ 6.7	$ 8.9	31.5%
R&D Expense	$ 0.9	$ 1.6	$ 1.8	$ 2.1	$ 3.0	34.7%
SG&A Expense	$ 2.1	$ 2.3	$ 3.3	$ 4.6	$ 5.9	30.0%
Operating Income	$ 2.5	$ 2.9	$ 3.9	$ 5.3	$ 7.8	33.7%
Other Income (Expense)	$ 0.1	$ 0.3	$ 0.4	$ 0.5	$ 0.5	40.7%
Income before Tax	$ 2.6	$ 3.2	$ 4.2	$ 5.8	$ 8.4	34.1%
NOTE: Pretax Margin	36%	34%	36%	38%	40%	
Taxes	$ 1.2	$ 1.4	$ 1.7	$ 2.4	$ 3.5	30.3%
NOTE: Effective Tax Rate	47%	44%	40%	42%	42%	
Discontinued Operations	-	-	($ 0.2)	($ 2.3)		
Net Income after Tax	$ 1.4	$ 1.8	$ 2.5	$ 3.2	$ 2.5	16.6%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	N/A	5.3	5.8	6.1	6.1	N/M
Per Share Data						
Earnings	$0.26	$ 0.34	$ 0.45	$ 0.57	$ 0.80	32.4%
Dividends	$0.08	$ 0.08	$ 0.10	$ 0.14	$ 0.16	18.9%
Book Value	N/A	$ 0.77	$ 2.40	$ 3.26	$ 3.50	N/M
Price Range (Low)	-	$ 25.00-	$ 16.67-	$ 8.50-	$ 10.75-	
(High)		39.75	26.50	19.67	23.13	
TOTAL EMPLOYEES	N/A	72	92	104	130	N/M
Revenue Per Employee	N/A	$128,069	$128,272	$147,442	$162,315	N/M

N/A = Not Available
N/M = Not Meaningful

Source: MacNeal-Schwendler Corporation
DATAQUEST
June 1986

The MacNeal-Schwendler Corporation
815 Colorado Boulevard
Los Angeles, California 90041
Telephone: (213) 258-9111 Telex: 4720462
(Millions of Dollars Except Per Share Data)

Line Items as a Percent of Revenue

	1981	1982	1983	1984	1985
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	66.9%	58.8%	64.9%	67.9%	69.3%
Non-United States	33.1%	41.2%	35.1%	32.1%	30.7%
Cost of Goods Sold	24.5%	26.2%	24.2%	21.5%	20.7%
Gross Margin	75.5%	73.8%	75.8%	78.5%	79.3%
Expenses	41.4%	42.2%	43.0%	43.9%	42.2%
R&D Expense	12.8%	17.7%	15.1%	14.0%	14.4%
SG&A Expense	28.5%	24.5%	28.0%	29.9%	27.8%
Operating Income	34.1%	31.5%	32.7%	34.6%	37.2%
Other Income (Expense)	1.9%	2.9%	3.1%	3.4%	2.6%
Income before Tax	36.1%	34.4%	35.9%	38.0%	39.8%
Taxes	17.0%	15.2%	14.4%	16.0%	16.7%
Net Income after Tax	19.0%	19.3%	21.5%	20.7%	12.0%

Source: MacNeal-Schwendler Corporation
DATAQUEST
June 1986

THE COMPANY

Founded

The MacNeal-Schwendler Corporation (MSC) was founded in California in 1963.

Positioning

MSC designs, produces, and markets mechanical computer-aided engineering (MCAE) software. MCAE software is used at the stage during which designs are subjected to engineering analysis before manufacturing begins.

MSC's principal product, MSC/NASTRAN, is a large, complex computer program that is based on finite element analysis (FEA). Using an FEA program, a mechanical engineer divides a complex structure into small components called elements. The FEA program then analyzes relationships between the elements to determine a structure's strength, safety, or performance characteristics. Typical applications include stress analysis, vibration analysis, acoustics, electromagnetics, and fluid/structure interaction.

MSC software products are generally leased. More than 90 percent of the Company's revenue comes from rents and royalties; approximately 50 percent of this revenue depends on the amount of program use. MSC's fiscal 1986 sales are as follows:

- 77 percent to industrial concerns
- 17 percent to data center networks
- 4 percent to government agencies
- 2 percent to universities

According to DATAQUEST estimates of MCAE's market share, MSC/NASTRAN is the dominant FEA software product. At fiscal year end 1985, the Company had 388 commercial leases, 91 university leases, 30 data center installations, and 602 installations worldwide. There were 60 net new agreements signed in fiscal 1986 and 115 new installations of MSC/NASTRAN.

Financial

MSC's initial public offering in May 1983 raised approximately $8.13 million. A second offering in August 1984 yielded almost $3.06 million. Both offerings were underwritten by Prudential-Bache Securities.

Highlights

Listed below in chronological order are highlights of the Company's most recent fiscal year:

- March 1986—Dr. Joseph Gloudeman was named to the post of chief executive officer, succeeding Dr. Richard MacNeal, who continues as chairman of the board.
- August 1985—MSC announced an after-tax write-off of $2.3 million from its unprofitable holdings in Modular Data Systems, Inc., a developer of process control software.
- 1985—MSC introduced MSC/pal 2, MSC/CASE, and MSC/mate for the IBM PC.

ORGANIZATION

Personnel Distribution

The Company's personnel at year-end 1985 were distributed as follows:

Department	Number of Employees
Technical Activities	84
Marketing	17
Administration	29
Total Employees	130

Facilities

The Company's Los Angeles, California, headquarters contains 21,000 square feet of space.

MARKETING AND SALES

Strategy

To attract customers, MSC leases its product with a relatively low initial cost. The continuing nature of lease relationships facilitates long-term customer loyalty and provides a predictable revenue base. The Company usually offers new versions of MSC/NASTRAN on an annual basis, and assures customers that they will be able to change computers while retaining MSC/NASTRAN.

Lease pricing for industrial installations is based on a minimum monthly rate or amount of use, whichever is greater. Lease pricing for data centers is a royalty based on percent of billings. MSC also offers low-cost leases to universities.

The Company's software runs on the full range of computers, from high-end mainframes to personal computers. MSC makes its software available for an expanding number of computers, including those manufactured by Amdahl, Apollo, Cray, Control Data, Data General, Digital Equipment, ELXSI, Floating Point Systems, Fujitsu, Hewlett-Packard, IBM, Itel, Prime, Ridge, Siemens, and Sperry.

Distribution

MSC leases and sells its software directly to users throughout the world and leases and sells through distributors in several countries outside the United States. The Company also has begun selling its PC products through dealers.

Locations of Sales and Support Operations

The Company's sales locations are as follows:

- U.S. direct sales and support offices
  - Los Angeles, California
  - Sacramento, California
  - Detroit, Michigan
  - New York City, New York
  - Philadelphia, Pennsylvania
  - Dallas, Texas
  - Milwaukee, Wisconsin
- Non-U.S. direct sales and support operations
  - Tokyo, Japan
  - Munich, West Germany

- Locations of non-U.S. representatives and distributors
  - Mendoza, Argentina
  - Sydney, Australia
  - Cedex, France
  - Madrid, Spain

Sales Support

MSC software upgrades are included as part of monthly lease fees.

Training

Formal training ranges from three-day introductory courses to intensive courses on specialized subjects.

MSC markets several educational tools designed to train users in MSC/NASTRAN. PRENASTRAN, priced at $95 to $295, is an interactive "refresher" program that can be used with a separate computer laboratory manual, priced at $27.50. The Company also sells a series of 30 color videotaped lectures on MSC/NASTRAN, leased at $500 to $1,000 per month on a month-to-month basis. A variety of user manuals are available.

Applications Support

The Company maintains a toll-free number and a "hot-line" service. Annual user group meetings are held in Los Angeles, California; Munich, West Germany; and Tokyo, Japan. The Company also publishes a bimonthly newsletter that includes program schedules, application routes, and updates.

MSC's Engineering Applications Department provides custom engineering for problems beyond the scope of the Company's packaged software.

STRATEGIC ALLIANCES

Mergers and Acquisitions

In 1984, MSC acquired a 35 percent interest in Modular Data Systems, a developer of process control software. In August 1985, the Company wrote off its unprofitable $2.3 million investment in Modular Data Systems. The write-off was classified as a discontinued operation.

Joint Developments

In 1985, the Company entered into an agreement with Synergistic Technology, Inc. (STI), to acquire a 50 percent ownership of STI's VAMP program. This program facilitates vibration testing and analysis. The two companies plan additional product development, joint marketing, and integrated client support.

Complementary Marketing Agreements

IBM salespersons have the right to market MSC/NASTRAN and its support progams. MSC pays no commission to IBM for these transactions.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past:

- August 1984—Introduced MSC/pal, the Company's first PC-based FEA software
- August 1984—Second public offering
- June 1984—Listed on American Stock Exchange
- May 1983—Initial public offering
- 1971—Introduced proprietary commercial version of NASTRAN
- 1965—Codeveloped original NASTRAN program for NASA
- 1963—Founded as a high-technology consulting firm

CAD/CAM PRODUCTS

Market Segment Participation

The Company sells unbundled MCAE finite element analysis software; users are concentrated in the aerospace, automotive, and tire and rubber industries.

Product Line

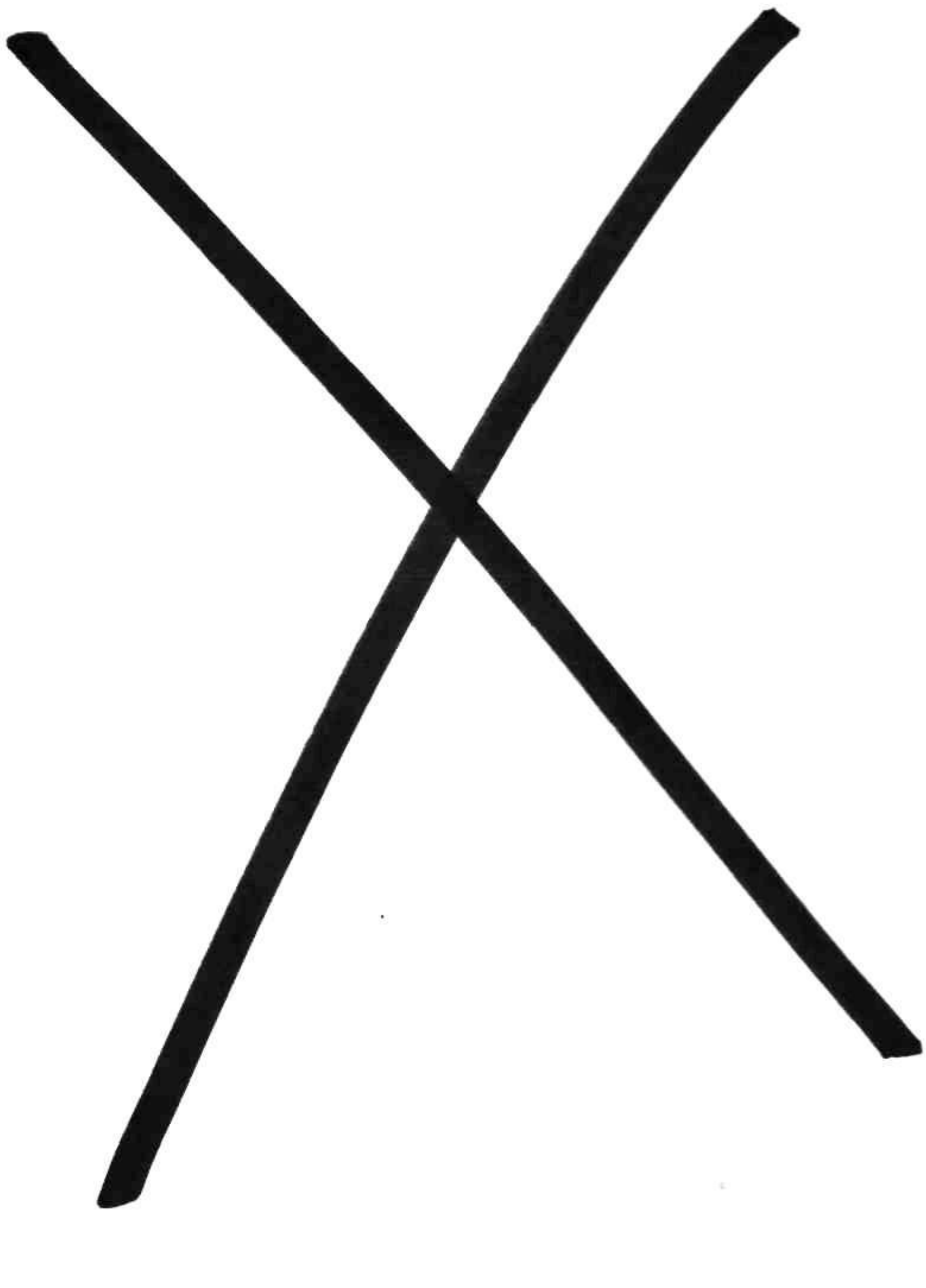
The Company's products are shown in Table 1.

Table 1

MacNeal-Schwendler Products

Model	Description
MSC/NASTRAN	Large-scale, general-purpose program that solves a wide variety of structural analysis problems using finite element methods to determine strength, safety, and performance characteristics; MSC/NASTRAN and complementary software are leased, not sold
The following software is used to complement MSC/NASTRAN:	
MSC/Access	Interface between MSC/NASTRAN and pre- and post-processors from other vendors
MSC/Grasp	Pre- and post-processing interactive color graphics software that provides model generation and output processing
MSC/SAT	Interactive simulation language that solves a set of differential equations
MSC/Trans	Transfers MSC/NASTRAN files between computers from different vendors
MSC/STI-VAMP	Signal analysis; vibration and acoustic testing and analysis
Aeroelasticity	Analysis of aerodynamic structures
CSAR/Sizing; CSAR/Optim	Design optimization and sizing
Superelements	Divides large finite element models into manageable subdivided structures that are analyzed separately
The following software is sold for IBM and compatible personal computers:	
MSC/pal	Three-dimensional mechanical design analysis using finite element method
MSC/pal 2	Expanded version of MSC/pal; accepts 3 times larger problems and contains more element types
MSC/Case	Structural and mechanical equation solution
MSC/Mate	Matrix equation solution

Source: DATAQUEST
June 1986



McDonnell Douglas Corporation

McDonnell Douglas Corporation
P. O. Box 516
St. Louis, Missouri 63166
(314) 232-0232

Corporate Financial Profile as of December 31
(Millions of Dollars Except Per Share and Employee Data)

	1982	1983	1984	1985	1986	CAGR 1982-1986
Balance Sheet Data						
Working Capital	$ 546.9	$ 276.4	($ 207.5)	$ 444.2	$ 634.7	3.8%
Long-Term Debt	$ 70.3	$ 60.0	$ 40.5	$ 603.1	$ 759.3	81.3%
Shareholder's Equity	$ 1,819.5	$ 2,057.0	$ 2,343.8	$ 2,634.6	$ 2,844.8	11.8%
After-Tax Return on Average Equity	12.4%	14.1%	14.8%	13.9%	10.1%	
Operating Performance						
Revenue	$ 7,331.3	$ 8,111.0	$ 9,662.6	$11,477.7	$12,831.5	15.0%
U.S. Revenue	$ 5,254.8	$ 6,006.3	$ 7,528.9	$ 8,809.4	$10,026.7	17.5%
Non-U.S. Revenue	$ 2,076.5	$ 2,104.7	$ 2,133.7	$ 2,668.3	$ 2,804.8	7.8%
Cost of Goods Sold	$ 6,084.1	$ 6,753.5	$ 7,885.4	$ 9,415.1	$10,439.1	14.5%
Gross Margin	$ 1,247.2	$ 1,357.5	$ 1,777.2	$ 2,062.6	$ 2,392.4	17.7%
Expenses	$ 1,016.5	$ 1,093.9	$ 1,440.0	$ 1,614.3	$ 1,828.6	15.8%
R&D Expense	$ 254.1	$ 301.2	$ 370.4	$ 423.1	$ 504.8	18.7%
SG&A Expense	$ 762.4	$ 792.7	$ 1,069.6	$ 1,191.2	$ 1,323.8	14.8%
Operating Income	$ 230.7	$ 236.6	$ 337.2	$ 448.3	$ 563.8	25.0%
Interest Income	($ 26.7)	($ 10.0)	($ 61.9)	($ 95.1)	($ 101.6)	
Other Income	$ 120.9	$ 181.8	$ 198.4	$ 188.1	0	(100.0%)
Income before Tax	$ 324.9	$ 435.4	$ 473.7	$ 541.3	$ 462.2	9.2%
NOTE: Pretax Margin	4.4%	5.4%	4.9%	4.7%	3.6%	(5.0%)
Taxes	$ 110.2	$ 160.5	$ 148.4	$ 195.6	$ 184.7	13.8%
NOTE: Effective Tax Rate	33.9%	36.9%	31.3%	36.1%	40.0%	4.2%
Extraordinary Credit						
Net Income after Tax	$ 214.7	$ 274.9	$ 325.3	$ 345.7	$ 277.5	6.6%
Shareholder Data						
Average Shares Outstanding (Millions)	39.3	39.5	40.1	40.3	40.6	0.8%
Per Share Data						
Earnings	$ 5.44	$ 6.91	$ 8.10	$ 8.60	$ 6.86	6.0%
Dividends	$ 1.24	$ 1.42	$ 1.62	$ 1.84	$ 2.08	13.8%
Book Value	$ 46.30	$ 52.33	$ 58.45	$ 65.37	$ 70.07	10.9%
Price Range (Low)	28 5/8	39 3/4	47 5/8	64 1/4	71	
(High)	44 1/2	62 3/4	73 3/4	87	91 1/8	
Total Employees	72,451	74,466	88,391	97,067	105,696	9.9%
Revenue Per Employee	$ 101,190	$ 108,922	$ 109,317	$ 118,245	$ 121,400	4.7%

N/A = Not Available
N/M = Not Meaningful

Source: McDonnell Douglas Corporation
Dataquest
April 1987

Line Items as a Percent of Revenue

	1982	1983	1984	1985	1986
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	71.7%	74.1%	77.9%	76.8%	78.1%
Non-United States	28.3%	25.9%	22.1%	23.2%	21.9%
Operating Performance					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	71.7%	74.1%	77.9%	76.8%	78.1%
Non-United States	28.3%	25.9%	22.1%	23.2%	21.9%
Cost of Goods Sold	83.0%	83.3%	81.6%	82.0%	81.4%
Gross Margin	17.0%	16.7%	18.4%	18.0%	18.6%
Expenses	13.9%	13.5%	14.9%	14.1%	14.3%
R&D Expense	3.5%	3.7%	3.8%	3.7%	3.9%
SG&A Expense	10.4%	9.8%	11.1%	10.4%	10.3%
Operating Income	3.1%	3.2%	3.5%	3.9%	4.4%
Interest Expense	(0.4%)	(0.1%)	(0.6%)	(0.8%)	(0.8%)
Other Income (Expense)	1.6%	2.2%	2.1%	1.6%	0
Income before Tax	4.4%	5.4%	4.9%	4.7%	3.6%
Taxes	1.5%	2.0%	1.5%	1.7%	1.4%
Net Income after Tax	2.9%	3.4%	3.4%	3.0%	2.2%

Source: McDonnell Douglas Corporation
Dataquest
May1987

THE COMPANY

Background

McDonnell Douglas Corporation (MDC) and its subsidiaries operate principally in four industry segments: combat aircraft, transport aircraft, space systems and missiles, and information systems. Within MDC, operations in the first three industry segments are conducted by the Aerospace Group. Operations in the information systems segment are conducted by the Information Systems Group (ISG); this group is dedicated to commercial activity. There are a number of ISG companies, the largest of which offer CAD/CAM products, health information systems, and the Tymnet network. In 1986, the ISG accounted for approximately 9 percent of MDC's revenue.

McDonnell Douglas Manufacturing and Engineering Systems Company is the ISG subsidiary responsible for CAD/CAM products. From 1960 to 1984, the CAD/CAM portion of this subsidiary was known as McAuto.

Positioning

MDC sells and supports turnkey systems and software for mechanical and AEC CAD/CAM applications. The Company derived 1.4 percent of its revenue from CAD/CAM markets in 1986. MDC's performance and market share history are shown in Tables 1 and 2.

Table 1

McDonnell Douglas
CAD/CAM Performance History
(Millions of Dollars and Actual Units)

	1982	1983	1984	1985	1986
Revenue	$ 37	$ 70	$ 129	$ 166	$ 183
Workstation Shipments	$256	$ 562	$1,052	$2,449	$2,015
Workstations Installed	$541	$1,103	$2,155	$4,604	$6,619

Source: McDonnell Douglas Corporation

Table 2

McDonnell Douglas
CAD/CAM Market Share History
(Percent of Segment)

	1982	1983	1984	1985	1986	1986 Rank in Market
All Applications						
Revenue	2%	2%	3%	3%	3%	5
Workstation Shipments	2%	3%	2%	4%	2%	8
Mechanical						
Revenue	4%	4%	5%	5%	4%	5
Workstation Shipments	5%	5%	3%	6%	2%	6
Facilities Design						
Revenue	0	1%	3%	4%	4%	5
Workstation Shipments	0	2%	2%	4%	3%	4

Source: McDonnell Douglas Corporation
Dataquest
May 1987

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- February 1987—MDC announced the StarFleet series of technical workstations based on the Company's GDS AEC software and Digital Equipment Corporation's VAXstation II/GPX.

- January 1987—The Company disbanded Productivity Systems, the mechanical CAD division that was established in 1985 with the goal of moving into the PC software market. The product, Crossroads 3-D, will still be sold by the Company's dealer network, but operations will be directed by MDC's major CAD/CAM operation, the Manufacturing and Engineering Systems.

- September 1986—MDC announced availability of the Unigraphics II product line on the VAXstation II/GPX technical workstation.

- May 1986—MDC announced Crossroads, a three-dimensional PC-based mechanical software package.

- March 1986—The Company introduced Access, software that allows an IBM PC with an EGA graphics card to emulate a Unigraphics II workstation.

- February 1986—MDC and Resource Dynamics, Inc. (RDI), announced an agreement calling for MDC to incorporate RDI's facilities management software into the Graphics Design System AEC product line.

ORGANIZATION

Personnel

Dataquest estimates that MDC employs approximately 900 people in its CAD/CAM operations. Of these employees, 35 percent are involved in sales, 22 percent are in client services, and 24 percent are in research and development.

CAD/CAM Operations

CAD/CAM operations and marketing are directed from the Company's headquarters in St. Louis, Missouri. Software development and systems integration are directed from offices in Cypress, California.

MARKETING AND SALES

Strategy

In AEC applications, Dataquest believes that MDC maintains a substantial number of sales of products based on host computers selling to its installed base of large civil engineering firms and state departments of transportation.

MDC differentiates its mechanical CAD products by:

- A strong interface to the company's manufacturing automation products, including shop floor numerical control, injection molding, factory data collection, and robotics

- A "hardware of choice" offering on host-based hardware from three vendors

MDC's annual report states that the Company has not been able to take advantage of the trend to smaller, less expensive CAD systems because its offerings have been concentrated in traditional host-based systems. MDC further states that it is now tailoring its software to run on smaller-scale equipment. At present, the company has no UNIX offering, although it has ported Unigraphics products to the UNIX operating system internally. The Company's CAD group claims to be able to offer UNIX-based systems whenever it elects to; Dataquest believes that the Company's in-house interfacing expertise makes this claim plausible. MDC has moved into PC-based mechanical PC CAD, with less than desired results. The Crossroads PC product, which is based on the previous 16-bit Unigraphics I offering, was originally sold by a separate business unit without using the McDonnell Douglas name. In February 1987, the Company clearly changed its PC CAD strategy by placing Crossroads under the control of MDC's CAD group.

MDC, as one of the largest defense contractors, is able to leverage internal design expertise in its commercial products. For example, the company's three-dimensional, mechanisms, and robotics software are derived from internally developed tools. Although internal users are MDC's largest customer base, MDC does not sell any of its aircraft-specific design products, which run on a separate design system based on IBM host computers.

Distribution

The Company sells its turnkey CAD systems direct in the United States and both direct and through distributors outside the United States. MDC maintains sales offices in 25 U.S. cities and in the following non-U.S. locations: Australia, Cologne, The Hague, London, Montreal, Paris, Singapore, Stockholm, and Toronto. The Company's distributors are located in Austria, Israel, Japan, and New Zealand.

PC-based software is sold through a network of approximately 60 U.S. dealers.

SALES SUPPORT

Warranties

The Company provides a 90-day warranty on all hardware and software sold.

Maintenance Agreements

MDC offers maintenance contracts with a four-hour response time. A toll-free number serves as a focal point for calls for hardware and software service.

Training

Training for turnkey systems is conducted at centers in Boston, New York, and St. Louis; it is also offered at the customer's site on request. Training sessions are typically five days in length. Training for PC-based software is through a tutorial manual.

STRATEGIC ALLIANCES

Mergers and Acquisitions

The Company has purchased the basis of much of its CAD software products. In 1985, MDC acquired Applied Research of Cambridge Ltd., the owner of MDC's AEC offering known as GDS. The Company has also purchased source code for PCB software from the former Vectron Graphics. In 1976, MDC acquired United Computing and the original Unigraphics product line.

OEM Agreements

In 1983, MDC first signed value added reseller and dealer agreements with IBM for host and personal computers. MDC is also a reseller of Data General host computers. In addition, the Company is a reseller of graphics workstations from both Tektronix and Megatek.

Cooperative Marketing Agreements

The Company participates in Digital Equipment Corporation's System Cooperative Marketing Program.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- April 1985—MDC bought Applied Research of Cambridge (ARC) Ltd. of Cambridge, England, a CAD system and software house. ARC offers turnkey CAD systems for AEC and mapping applications; it also supplies MDC's GDS AEC software.
- November 1984—MDC became a value-added remarketer for IBM host computers.
- November 1984—The Company announced the D-2300 graphics display system based on Megatek's Merlin 9200. The unit offers 3,072 x 2,304 resolution with 4,000 displayable colors. Features include real-time animation of mechanisms and a switch to alternate between wireframe and shaded views.
- June 1984—MDC introduced an Ethernet-based local area network to connect Unigraphics systems running on IBM, Digital Equipment, and Data General hardware.

- March 1984—MDC announced the formation of a new corporate organization consisting of McDonnell Douglas Automation Company (McAuto), Microdata Corp., Vitek Systems, and the newly acquired Tymshare. The new entity was called the Information Systems Group.

- January 1984—MDC acquired Computer Sharing Services, Inc. (CSS), which primarily sells computers and data processing services to telephone companies. CSS operated as a subsidiary of McAuto.

- November 1983—McAuto introduced UniPCB, a PCB software package for computers from Digital Equipment and Data General. The package is based on software from Vectron Graphic Systems of Santa Clara, California.

- May 1983—McAuto acquired Insight Technology and its Master Link product line, a shop-floor numerical control system based on Data General computers.

- March 1983—The Company introduced Unigraphics II, a 32-bit version of the company's mechanical CAD software, running on computers from Digital Equipment and Data General. The product includes interfaces to the Company's PLACE robotics software, the Master Link numerical control system, and the previous Unigraphics I software.

- 1981—The Company introduced its AEC offerings, the general drafting system (GDS) and the three-dimensional building design system (BDS) developed by Applied Research of Cambridge Ltd. The software runs on minicomputers from Digital Equipment and Prime Computer.

- 1976—The Company purchased United Computing, thus acquiring the Unigraphics product line.

- 1960—McAuto was founded, with the charter of providing computer services and systems to both internal operations and outside customers.

CAD/CAM PRODUCTS

MDC sells mechanical turnkey CAD systems that run on IBM, Digital Equipment, and Data General host computers under the Unigraphics product name. The Company's AEC product, GDS (formerly known as GDS/BDS), is sold as a turnkey system on Digital Equipment computers and as software on Prime computers. In addition, MDC offers PC-based mechanical and AEC CAD software.

MDC's mechanical CAD products interface with the Company's manufacturing automation product line, which includes the following:

- Master Link shop-floor numerical control system based on Data General computers
- PlantCom factory data collection system based on IBM Series/1 host computers
- Robotics software and turnkey systems

McDonnell Douglas offers two principal interface products:

- UG Net, which allows communications and file transfer among Unigraphics systems on IBM, Data General, and Digital Equipment computers
- Factory Interface Management, which provides scheduling, file transfer, and error detection and correction between any Unigraphics system and MDC's manufacturing automation product line

CAD Product Line

McDonnell Douglas Corporation's CAD products are listed in Table 3. The pages following this table provide a detailed description of each product, with one product per page. These product description pages are presented in the order in which the products appear in Table 3.

Table 3

McDonnell Douglas
CAD Products

TECHNICAL WORKSTATIONS

Model	Manufacturer	Resolution	Description
StarFleet	Digital Equipment	1,024 x 864	VAXstation II/GPX-based system includes 19-inch color monitor, windowing, GDS software; MicroVMS operating system; for AEC applications
VAXstation II/GPX	Digital Equipment	1,024 x 864	Unigraphics system based on VAXstation II/GPX; five modular packages: CAD, MCAE, machine component design and analysis, numerical control, and file management; MicroVMS operating system; for mechanical applications

HOST SYSTEMS

Model	Manufacturer	Number of Users	Description
VAX or MicroVAX	Digital Equipment	N/A	GDS-based system for AEC applications

(Continued)

Table 3

McDonnell Douglas (Continued)
CAD Products

HOST SYSTEMS (Continued)

Model	Manufacturer	Number of Users	Description
VAX or MicroVAX	Digital Equipment	14	Up to 14 users on VAX-based system using Tektronix workstations; includes Unigraphics II design/drafting software VMS operating system; for mechanical applications
IBM 4381	IBM	23	Unigraphics system based on IBM's 4381 host computer and 5080 display system; VM operating system; for mechanical applications

HOST-DEPENDENT WORKSTATIONS

Model	Resolution	Displayable Colors	Description
Unigraphics II, Access	N/A	N/A	Software allowing IBM PC/XT or /AT to emulate Unigraphics host-dependent workstation
Unigraphics II, D2300	3,072 x 2,304	4,096	Manufactured by Megatek; for Unigraphics system
Unigraphics II, D41XX	1,024 x 768	16	Manufactured by Tektronix; for Unigraphics system

APPLICATION SOFTWARE

Model	Platform	Segment	Description
Crossroads	PC	Mechanical	Optional file transfer from Crossroads to Unigraphics; functions include two-dimensional, three-dimensional, solids, drafting; runs on IBM PC
FM/PC	PC	AEC	Facilities management software; Modules included are inventory, forecasting, affinity, building profile, analysis of leases based on building profile, and data base; runs on IBM PC
GDS	Host-Dependent	AEC	Core software includes three-dimensional drafting/documentation module and data base management system; runs on Digital Equipment or Prime computer
GDS, Architectural Site Modeler	Host-Dependent	AEC	Three-dimensional models of building sites; functions include three-dimensional, architectural; runs on GDS core software
GDS, Duct Designer	Host-Dependent	AEC	Functions include HVAC
GDS, FMDS	Host-Dependent	AEC	Facilities Management Decision System (FMDS); includes FAST software (Forecast, Affinity, Stack, Track); runs on GDS core software

(Continued)

Table 3

McDonnell Douglas (Continued)
CAD Products

APPLICATION SOFTWARE (Continued)

GDS, Solid Modeler	Host-Dependent	AEC	Solid modeling software; Assembly Modeler option allows manipulation of three-dimensional components in a two-dimensional environment for interference checking, perspective images; runs on GDS core software
GDS, Structural Designer	Host-Dependent	AEC	Structural design module
Unigraphics II, Design/Drafting	Host-Dependent, Technical Workstation	Mechanical	Core software includes two-dimensional, three-dimensional, drafting functions; runs on Digital Equipment, Data General, or IBM Computer; optional interface to Interleaf technical publications software
Unigraphics II, Assemblies and Components	Host-Dependent, Technical Workstation	Mechanical	Group technology module
Unigraphics II, Electrical Design	Host-Dependent, Technical Workstation	Mechanical	Schematic capture and PCB layout; combines Graphics Schematics Module (GSM) and UNIPCB board layout module; board designs may be integrated with mechanical assemblies
Unigraphics II, Flat Pattern	Host-Dependent, Technical Workstation	Mechanical	Flat pattern module; runs on Unigraphics design/drafting software
Unigraphics II, GFEM	Host-Dependent, Technical Workstation	Mechanical	GFEM finite element modeler interfaces to ANSYS and NASTRAN analysis programs and to Moldflow mold design software
Unigraphics II, Machine Elements	Host-Dependent, Technical Workstation	Mechanical	Parametric design, analysis, and optimization of gears, shafts, and cams
Unigraphics II, Mechanisms	Host-Dependent, Technical Workstation	Mechanical	Mechanisms/kinematics module with optional interface to ADAMS and DRAM analysis software; functions include mechanisms/kinematics
Unigraphics II, Nesting	Host-Dependent, Technical Workstation	Mechanical	Nesting module; runs on Unigraphics design/drafting software
Unigraphics II, Unipix	Host-Dependent, Technical Workstation	Mechanical	Shading module for presentation graphics, surface evaluation, and technical illustrations
Unigraphics II, Unisolids	Host-Dependent, Technical Workstation	Mechanical	Solid modeler; runs on Unigraphics design software

N/A = Not Available

Source: Dataquest
May 1987

CAD PRODUCT DESCRIPTION

Price: $45000

Model: GDS. StarFleet
Type: Technical Workstation System for AEC Applications

System Configuration:

Manufacturer: Digital Equipment
Operating System. MicroVMS
Communication Protocols: Ethernet
Microprocessor: prop
Word size: 32
5.0 Mbyte main memory included.
71 Mbyte disk memory included.

CAD Application Software:
two-dimensional, three-dimensional, drafting

Comments:
Based on VAXstation II/GPX. Includes 19-inch color monitor, windows.
Software only price: approximately $20,000

8704-0810-3654 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $26000

Model: Unigraphics II, DEC VAXstation II/GPX
Type: Technical Workstation System for Mechanical Applications

Date of product introduction: 9/86

System Configuration:

Manufacturer: Digital Equipment
Operating System: MicroVMS
Communication Protocols: Ethernet
Microprocessor: prop
Word size: 32

Workstation Configuration:

Manufacturer: Digital Equipment
1024 x 864 resolution. 16 displayable colors

CAD Application Software:
two-dimensional, three-dimensional, drafting

Comments:
Based on VAXstation II/GPX. Five modular packages: CAD, MCAE, machine component design and analysis, numerical control, and file management; prices range from $26,000 to $54,000

8616-2989-4444 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $70000

Model: GDS, VAX or MicroVAX
Type: Host Computer System for AEC Applications

System Configuration:

Manufacturer: Digital Equipment

CAD Application Software:
two-dimensional, three-dimensional, drafting

Comments:
Price is per seat for low end system

8703-2316-3315 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $725000

Model: Unigraphics II, DEC 8500
Type: Host Computer System for Mechanical Applications

System Configuration:

Manufacturer: Digital Equipment
Operating System: VMS
Communication Protocols: Ethernet
Microprocessor: prop
Word size: 32

14 workstations included

Workstation Configuration:

Manufacturer: Tektronix

Upgrade description: Megatek 9200 workstations

CAD Application Software:
two-dimensional, three-dimensional, drafting

Comments:
14-User Digital 8500 system using Tektronix D4111 workstations. Includes Unigraphics II design/drafting software

8610-2986-5617 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $175000

Model: Unigraphics II, DEC MicroVAX II
Type: Host Computer System for Mechanical Applications

System Configuration:

Manufacturer: Digital Equipment
Operating System: MicroVMS
Communication Protocols: Ethernet
Microprocessor: prop
Word size: 32

4 workstations included. 5 users maximum

Workstation Configuration:

Manufacturer: Tektronix
1024 x 768 resolution. 16 displayable colors
Upgrade description: Megatek 9200 workstations

CAD Application Software:
two-dimensional, three-dimensional, drafting

Comments:
4-user MicroVAX configuration using Tektronix D4111 workstations.
Includes Unigraphics II design/drafting software

8618-2908-5395 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $215000

Model: Unigraphics II, IBM 4381
Type: Host Computer System for Mechanical Applications

System Configuration:

Manufacturer: IBM
Operating System: VM
Communication Protocols: SNA

3 workstations included. 23 users maximum

Workstation Configuration:

Manufacturer: IBM
1024 x 1024 resolution. 16 displayable colors

CAD Application Software:
two-dimensional, three-dimensional, drafting

Comments:
Based on IBM's 4381 host computer and 5080 display system. Price range for 3 to 23 users: $215,000 to $850,000

8703-2310-4026 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $6800

Model: Unigraphics II, Access
Type: Host-Dependent Workstation for Mechanical Applications

Date of product introduction: 3/86

Prerequisites:
IBM PC/XT or /AT

Comments:
Access is software that allows PC to emulate Unigraphics II workstation.
Price is single user license fee.

6783-1209-3138 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $39000

Model: Unigraphics II, D135
Type: Host-Dependent Workstation for Mechanical Applications

Workstation Configuration:

1024 x 1024 resolution. 16 displayable colors

Comments:
Dual display.

8703-1709-0256 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $49000

Model. Unigraphics II, D2300
Type: Host-Dependent Workstation for Mechanical Applications

Workstation Configuration:

Manufacturer: Megatek
3072 x 2304 resolution. 4096 displayable colors

Prerequisites:
Unigraphics system

Comments:
Dual screen. Real-time animation of mechanisms. Based on Megatek Merlin 9200. Price ranges up to $65,000

8703-1708-5812 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $14000

Model: Unigraphics II, D41XX
Type: Host-Dependent Workstation for Mechanical Applications

Workstation Configuration:

Manufacturer: Tektronix
1024 x 768 resolution. 16 displayable colors

Prerequisites:
Unigraphics System

Comments:
Price is for Model D4111. Price ranges up to $32,000 for Models D4125, D4128, D4129--with up to 1280 X 1024 resolution and 256 displayable colors. All models are single screen with windowing

8783-1786-5614 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Model: Unigraphics II, UG Net
Type: Communications Software for Mechanical Applications
Hardware Platform: Host-Dependent

Comments:
Network which links Unigraphics systems on IBM, Data General, and Digital Equipment computers

8703-3116-0025 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $2995

Model: Crossroads
Type: CAD Application Software for Mechanical Applications
Hardware Platform: PC
Date of product introduction: 5/86

CAD Application Software:
two-dimensional, three-dimensional, solids
drafting

Prerequisites:
IBM PC

Comments:
Options include transfer from Crossroads to Unigraphics, and transfer from AutoCAD to Crossroads ($795)

8763-1789-3882 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $20000

Model. FM/PC
Type: CAD Application Software for AEC Applications
Hardware Platform: PC
Date of product introduction: 4/86

CAD Application Software:
facilities management

Prerequisites:
IBM PC

Comments:
Modules included are inventory, forecasting, affinity, building profile, analysis of leases based on building profile, and data base. Based on software from Resource Dynamics.

0765-1710-1940 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $10000

Model: GDS, Architectural Site Modeler
Type: CAD Application Software for AEC Applications
Hardware Platform: Host-Dependent
Date of product introduction: 7/86

CAD Application Software:
three-dimensional, architectural

Prerequisites:
GDS core software

Comments:
Three-dimensional models of building sites. Low end price

8703-2309-4603 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Model: GDS, Duct Designer
Type: CAD Application Software for AEC Applications
Hardware Platform: Host-Dependent

CAD Application Software:
HVAC

8703-2010-0140 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Model: GDS, FMDS
Type: CAD Application Software for AEC Applications
Hardware Platform: Host-Dependent

CAD Application Software:
facilities management

Prerequisites:
GDS/BDS core software

Comments:
Facilities Management Decision System (FMDS) based on software from Resource Dynamics. Includes FAST software (Forecast, Affinity, Stack, Track).

8783-2389-4349 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $38000

Model: GDS
Type: CAD Application Software for AEC Applications
Hardware Platform: Host-Dependent

CAD Application Software:
two-dimensional, three-dimensional, drafting

Prerequisites:
Digital Equipment or Prime computer

Comments:
This core software includes drafting/documentation module and data base management system. Bidirectional transfer with Intergraph or CV: $10K. IGES translator: $7.5K. Unigraphics software license on low-end Prime computer: $38K for 1 user, $71K for 4 users

8703-2009-5322 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $10000

Model: GDS, Solid Modeler
Type: CAD Application Software for AEC Applications
Hardware Platform: Host-Dependent
Date of product introduction: 7/86

CAD Application Software:
drafting, solids

Prerequisites:
GDS core software

Comments:
Assembly Modeler option, at $3K, allows manipulation of 3D components in a 2D environment for interference checking, perspective images

8703-2309-5154 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price. $5000

Model: GDS, Structural Designer
Type: CAD Application Software for AEC Applications
Hardware Platform: Host-Dependent

CAD Application Software:
structural

Comments:
Low end pricing

8703-2010-0247 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Model: Unigraphics II. Assemblies and Components
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
group technology

8783-1789-3523 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $10000

Model: Unigraphics II, Design/Drafting
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
two-dimensional, three-dimensional, drafting
technical publications

Language used: FORTRAN

Prerequisites:
Digital Equipment, Data General, or IBM Computer

Comments:
Per seat price: $10,000 to $20,000. Optional interface to Interleaf technical publications software package

8703-1789-2731 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $3400

Model: Unigraphics II, Electrical Design
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
schematic capture, PCB layout

Comments:
Combines Graphics Schematics Module (GSM) and UNIPCB board layout module. Board designs may be integrated with mechanical assemblies. Per seat price: $3,400 to $8,500

8703-1709-1518 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $8500

Model: Unigraphics II, Flat Pattern
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
flat pattern

Comments:
Price is for master processing system software for any CPU

8703-1709-3629 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $1000

Model: Unigraphics II, GFEM
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
FEM/FEA, mold design/analysis

Comments:
GFEM is finite element modeler which interfaces to ANSYS and NASTRAN analysis programs, and to Moldflow mold design software. Per seat price: $1,000 to $3,800

8783-1709-3145 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $1000

Model: Unigraphics II, Machine Elements
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation
Date of product introduction: 4/86

CAD Application Software:
design/analysis

Comments:
Parametric design, analysis, and optimization of gears, shafts, and cams.
Per seat price: $1,000 to $3,600

8703-1709-1740 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price. $750

Model: Unigraphics II, Mechanisms
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
mechanisms/kinematics

Comments:
Optional interface to ADAMS and DRAM analysis software. Per seat price: $750 to $3000

8703-1709-2250 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $8500

Model: Unigraphics II, Nesting
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
nesting

Comments:
Price listed is for master processing system software for any CPU

8703-1709-3538 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $1000

Model: Unigraphics II, Unipix
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
design/analysis, technical publications

Comments:
Shading module for presentation graphics, surface evaluation, and technical illustrations. Per seat price: $1,000 to $2,000

8703-1789-1954 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Price: $2000

Model: Unigraphics II, Unisolids
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Host-Dependent, Technical Workstation

CAD Application Software:
solids

Prerequisites:
Unigraphics design software

Comments:
Per seat price: $2,000 to $8,000

8703-1799-5237 MCDONNELL DOUGLAS

CAD PRODUCT DESCRIPTION

Model: Unigraphics II, Factory Interface Management
Type: Miscellaneous Software for Mechanical Applications
Hardware Platform: Host-Dependent

Comments:
Interface between any Unigraphics system and McDonnell-Douglas manufacturing automation products. Includes scheduling, utilities, file transfer, error detection/correction

8703-3116-8421 MCDONNELL DOUGLAS

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Mentor Graphics Corporation

Mentor Graphics Corporation
8500 S.W. Creekside Place
Beaverton, OR 97005
Telephone: (503) 626-7000
(Millions of Dollars except Per Share and Employee Data)

(Corporate Financial Profile as of December 31)

	1982	1983	1984	1985	1986	CAGR 1982-1986
Balance Sheet Data						
Working Capital	$2.0	$4.1	$58.6	$106.6	$122.3	180.7%
Long-Term Debt	$0.2	$0.1	0	0	0	(100.0%)
Shareholders' Equity	$2.7	$10.3	$71.2	$140.1	$155.2	175.4%
After-Tax Return on Average Equity	(153.4%)	(3.7%)	24.2%	7.6%	7.4%	
Operating Performance (Fiscal Year Ending December 31)						
Revenue	$1.7	$25.8	$87.9	$136.7	$173.5	216.7%
U.S. Revenue	$1.7	$25.8	$69.7	$88.9	$97.2	173.9%
Non-U.S. Revenue	N/A	N/A	$18.2	$47.9	$76.4	N/M
Cost of Goods Sold	$0.9	$14.5	$51.7	$78.6	$96.5	222.0%
Gross Margin	$0.8	$11.3	$36.2	$58.2	$77.1	210.5%
Expenses	$2.9	$11.4	$27.2	$50.6	$64.6	117.3%
R&D Expense	$1.0	$2.9	$7.7	$14.5	$16.8	100.9%
SG&A Expense	$1.9	$8.5	$19.4	$36.0	$47.8	124.9%
Other Expenses	0	0	0	0	0	0
Operating Income	($2.1)	($0.2)	$9.1	$7.6	$12.4	N/M
Interest Income (Expense)	0	($0.1)	0	0	0	N/M
Other Income	0	0	$4.5	$4.5	$4.1	N/M
Income before Tax	($2.1)	($0.2)	$13.6	$12.1	$16.5	N/M
Pretax Margin	(120.0%)	(0.9%)	15.5%	8.8%	9.5%	
Extraordinary Item*	0	0	$1.5	0	0	N/M
Taxes	0	0	$5.3	$4.1	$5.5	N/M.
Effective Tax Rate	0	0	38.8%	33.9%	33.5%	
Net Income after Tax	($2.1)	($0.2)	$9.9	$8.0	$11.0	N/M
Shareholder Data						
Average Shares Outstanding (Millions)	0.4	2.6	13.9	15.5	16.4	152.9%
Per Share Data						
Earnings	($4.85)	($0.09)	$0.60	$0.52	$0.67	N/M
Dividends	0	0	0	0	0	0
Book Value	$6.75	$3.98	$5.13	$9.04	$9.48	8.9%
Price Range (Low)	N/A	N/A	16	13-3/8	11-3/8	
(High)	N/A	N/A	25-1/8	28-3/4	19-1/4	
Total Employees	36	192	528	777	909	124.2%
Revenue per Employee	$47,944	$134,375	$166,477	$175,995	$190,919	41.3%

*Net operating loss carry forward.
N/M = Not Meaningful
N/A = Not Available

Source: Mentor Graphics Corporation
Dataquest
June 1987

Line Items as a Percent of Revenue

	1982	1983	1984	1985	1986
Operating Performance					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	100.0%	100.0%	79.3%	65.0%	56.0%
Non-United States	0	0	20.7%	35.0%	44.0%
Cost of Goods Sold	52.0%	56.3%	58.8%	57.5%	55.6%
Gross Margin	48.0%	43.7%	41.2%	42.5%	44.4%
Expenses	168.0%	44.4%	30.9%	37.0%	37.2%
R&D Expense	59.7%	11.4%	8.8%	10.6%	9.7%
SG&A Expense	108.3%	33.0%	22.1%	26.3%	27.6%
Other Expenses	0	0	0	0	0
Operating Income	(120.0%)	(0.7%)	10.3%	5.6%	7.2%
Interest Income (Expense)	0	(0.3%)	0	0	0
Other Income (Expense)	0	0	5.2%	3.3%	2.4%
Income before Tax	(120.0%)	(0.9%)	15.5%	8.8%	9.5%
Taxes	0	0	6.0%	3.0%	3.2%
Net Income after Tax	(120.0%)	(0.9%)	11.2%	5.8%	6.3%

Source: Mentor Graphics Corporation
Dataquest
June 1987

THE COMPANY

Founded

Mentor Graphics Corporation was incorporated in Oregon in April 1981.

Positioning

Mentor Graphics sells and supports turnkey EDA CAD systems using technical workstations from Apollo Computer for ECAE, IC layout, and PCB layout applications. In addition, the Company sells and supports ECAE software for the IBM PC. The Company derives all of its revenue from EDA markets. Mentor Graphics' performance and market share history are shown in Tables 1 and 2. Figure 1 shows the Company's sales by industry.

Table 1

Mentor CAD/CAM Performances
(Millions of Dollars and Actual Units)

	1982	1983	1984	1985	1986
Revenue	$2	$26	$88	$137	$174
Workstation Shipments	35	462	1,347	1,382	1,900
Workstations Installed	35	497	1,844	3,226	5,126

Source: Dataquest
June 1987

Table 2

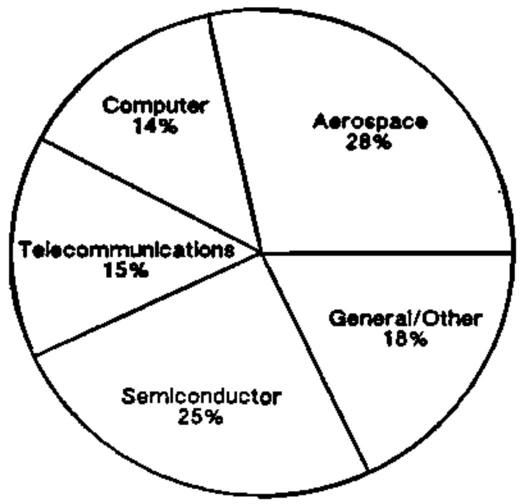
Mentor CAD/CAM Market Share History
(Percent of Segment)

	1982	1983	1984	1985	1986	1986 Rank in Market
All Applications						
Revenue	0	1%	2%	2%	2%	7
Workstation Shipments	0	3%	2%	1%	1%	10
Electronic CAE						
Revenue	3%	17%	19%	16%	16%	1
Workstation Shipments	10%	29%	14%	8%	7%	3
IC Layout						
Revenue	0	0	1%	4%	6%	4
Workstation Shipments	0	0	1%	5%	7%	5
PCB Layout						
Revenue	0	0	0	0	1%	20
Workstation Shipments	0	0	0	0	1%	18

Source: Dataquest
June 1987

Figure 1

1986 Mentor Graphics Worldwide Sales by Industry



Source: Mentor Graphics
1987 Annual Report

FINANCIAL

Mentor received initial private financing of $1 million in 1981 from Venrock Associates, Sutter Hill, and Greylock. In July 1982, Mentor Graphics received $2 million from the above firms, joined by Hambrecht & Quist and L. F. Rothschild. In April 1983, the Company received an additional $7 million from the above concerns, joined by 11 other venture capital firms.

The initial public offering in 1984 netted the Company $51 million. A second public offering in May 1985 yielded $57.9 million.

HIGHLIGHTS

Listed below in reverse chronological order are recent company highlights:

- June 1987—The Company announced that it had purchased exclusive rights to Caedent Corporation's product line and technology, which include fault simulation and design-for-test software. Key Caedent employees joined Mentor Graphics.

- June 1987—The Company announced an agreement with Logic Automation, Inc. to offer that company's LSI/VLSI modeling products for system-level simulation. These products are intended to complement Mentor Graphics' Hardware Modeling Library.

- June 1986—Mentor introduced REMEDI, a graphic schematic-to-layout debugging module that operates in conjunction with the Company's ChipGraph custom IC layout editor and Dracula II layout verification package.

- June 1986—Mentor Graphics announced an agreement with Test Systems Strategies, Inc. (TSSI), under which TSSI's products will generate test programs using simulation data from Mentor Graphics' Idea Station for a variety of automatic test equipment, including LSI testers from Sentry and GenRad.

- June 1986—The Company announced an agreement with Silicon Compilers, Inc., to integrate SCI's Genesil silicon compiler on the IDEA Series of Engineering Workstations.

- April 1986—Mentor Graphics purchased the remaining one-third ownership interest of its partner, Marubeni Hytech, in the joint venture Mentor Graphics Japan Co., Ltd., bringing the Company's ownership to 100 percent.

- February 1986—The Company formed Context Corporation and acquired an initial interest of 85 percent in the newly-formed subsidiary. Context was formed to enhance and market the document preparations products previously developed by Mentor Graphics for the electronic technical publications market.

- February 1986—The Company announced that its entire product line would be available on Apollo's Series 3000 workstation.

ORGANIZATION

Personnel Distribution

Personnel are distributed as follows:

Location	Percent of Employees
North American sales/support	25%
Rest of World sales/support	22%
Beaverton facility, all functions	45%
San Jose R&D facility	8%

Facilities

Mentor Graphics maintains 233,000 square feet of space at its Beaverton, Oregon, headquarters used for all Company operations. In addition, the Company's San Jose, California, Automated Layout Division develops automated IC and PCB layout products.

MARKETING AND SALES

Strategy

Mentor Graphics has risen from approximate parity with its traditional competitors, Daisy and Valid Logic, to a commanding market position. The Company's initial decision to offer products solely on Apollo computers has paid off. Development costs for hardware interfacing and integration have been minimal, and the Company has not had to endure the cost of such activities as porting software to new hardware. At this time, the Company appears to be committed to its Apollo-only hardware strategy.

In the past, Mentor Graphics has added to its software product line in a variety of ways: through internal development, acquisition, OEM agreements, cooperative marketing pacts, and by creating a subsidiary. The Company is likely to continue this eclectic approach to adding software products. The Company states that future developments will be limited to the product development needs of electronics manufacturing companies.

Mentor Graphics emphasizes sales to major accounts. It regards these accounts as a key source of future repeat sale revenue. The Company occasionally solidifies its position with major accounts through joint product development agreements. Mentor Graphics has such agreements with Advanced Micro Devices, Boeing, and Hughes Aircraft.

Distribution

The Company sells its products almost exclusively through a direct sales force located in 20 U.S. cities and through wholly owned marketing subsidiaries in Australia, Canada, Japan, Hong Kong, Korea, Taiwan, France, Italy, The Netherlands, Scotland, West Germany, Singapore, Sweden, Switzerland, and the United Kingdom. The Company maintains 39 sales offices worldwide. In addition, the Company has distributors in Israel and Spain.

SALES SUPPORT

Warranties

Mentor offers a 90 day warranty for its products.

Maintenance Agreements

Mentor Graphics offers both software and system maintenance agreements. New software releases are provided at no charge to users with a maintenance agreement. The Company states that it is decreasing the use of subcontracted hardware service from Apollo, with the goal of providing direct hardware service to more than 50 percent of its customers by the end of 1987.

Training

The Company maintains training centers in Boston, Dallas, San Jose and Portland, as well as in London, Munich, Paris, and Tokyo. Typical training courses are three to five days long.

STRATEGIC ALLIANCES

Subsidiaries

In January 1986, Mentor Graphics formed and primarily financed Context Corporation, a company focused on the technical documentation market. The company's product, known as the Context Series of Documentation Workstations, is based on Mentor Graphics' DOC software and Apollo technical workstations.

Mergers and Acquisitions

In September 1984, the Company acquired acceleration and modeling capabilities with its purchase of Synergy DataWorks of Portland, Oregon.

In September 1983, Mentor Graphics merged with California Automated Design Incorporated (CADI), a San Jose, California, producer of gate array and standard cell design software. Today, that San Jose company is headquarters of Mentor Graphics'Automated Layout Division.

OEM and Cooperative Marketing Agreements

Mentor Graphics sells both MSIMON analog simulation software and Dracula II IC layout verification software from ECAD, Inc. In addition, the Company sells circuit simulation software with parts library from Analog Design Tools under the name MSpice Plus.

Mentor Graphics supports two silicon compilers on its IDEA Series workstations. These include the Concorde compiler from Seattle Silicon and the Genesil compiler from Silicon Compiler Systems Corp.

The Company has formal agreements for standard cell libraries from MOSIS and NCR. Gate array vendor libraries, supported from logic design through physical layout, include Gould Semiconductor, Motorola, Honeywell, NEC, Laserpath, and Thomson-CSF/Mostek. The effect of these agreements is to permit the IDEA Series user to perform the front-end logic design functions of a semicustom circuit with the design requirements of a specific IC manufacturer. The user then has the choice of sending the extracted net list to the IC manufacturer for physical layout and final simulation, or of completing the physical layout in-house. In addition, other vendor libraries are supported to the level of front-end design.

Joint Development Agreements

The Company has joint product development agreements with several major accounts, including Advanced Micro Devices, Boeing, and Hughes Aircraft.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's history in the CAD/CAM industry:

- October 1985—Mentor announced the Compute Engine accelerator, a parallel processor-based system executed on two add-in boards for IDEA workstations.

- August 1985—The Company introduced Entry Station, an ECAE software package for the IBM PC XT and AT.

- June 1985—The Company announced QUICKSIM, a family of analysis tools for logic and fault simulation and timing analysis.

- June 1985—The Company announced an agreement with Seattle Silicon Technology to integrate that company's Concorde silicon compiler on the IDEA Series of Engineering Workstations.

- May 1985—The Company announced Board Station, a printed circuit board design system that is part of the IDEA series.

- April 1985—The Company announced that ECAD Incorporated's Dracula II layout verification and mask data preparation software is available for the IDEA series Chip Station IC layout workstation.

- May 1985—Mentor Graphics announced QuickParts, a component part library for the IDEA series.

- March 1985—The Company announced the Hardware Modeling Library (HML) for the logic and fault simulation of actual components.

- March 1985—The Company announced a joint technology agreement with Gould AMI, Fairchild, and VLSI Technology, Inc., for the use of these companies' logic and physical gate array libraries.

- February 1985—The Company announced an agreement with Simon Software, Inc., for software used in Mentor Graphics' MSIMON circuit simulation product for MOS and CMOS devices. Simon Software, Inc., was later purchased by ECAD, Inc.

- February 1985—NCR and Mentor Graphics signed a joint marketing agreement for NCR CMOS cell libraries.

- September 1984—Mentor Graphics acquired Synergy DataWorks, a Portland, Oregon, manufacturer of accelerators.

- May 1984—The Company entered into a joint marketing venture with its Japanese distributor, Marubeni Hytech Co. The Company acquired a direct sales force in Japan as a result of its majority ownership in the new company, which is called Mentor Graphics Japan Co., Ltd.

- March 1984—The Company introduced standard cell IC layout software and ChipGraph, a full-custom IC editor.

- January 1984—The Company signed an OEM agreement with HHB-Softron for HHB's CADAT concurrent fault simulation software.

- September 1983—The Company merged with California Automated Design, Inc., a San Jose, California, producer of gate array and standard cell design software.

- June 1983—Mentor Graphics (Deutschland) GmbH was established.

- March 1983—Mentor Graphics (U.K.) Limited was established.

- March 1983—Mentor Graphics selected Marubeni Hytech Co. of Tokyo, Japan, as its Japanese distributor.
- November 1982—The Company shipped its first product, the IDEA Series EDA workstation.
- April 1981—Mentor Graphics was incorporated in Oregon.

CAD/CAM PRODUCTS

Mentor sells and supports the IDEA series of turnkey electronic CAD systems using technical workstations from Apollo Computer. In general, additional Mentor Graphics products may be added to existing workstations. The Company does not sell unbundled core software for technical workstations. Mentor Graphics also sells ECAE software for IBM PCs.

The Company's products are summarized in Table 3. The pages following this table provide a detailed description of each product, with one product per page. These product pages are presented in the order in which they appear in Table 3.

Table 3

Mentor Graphics Products

TECHNICAL WORKSTATIONS

Model (IDEA Series)	Manufacturer	Resolution	Description
Capture Station	Apollo	1,280 x 1,024	Includes DBMS, NETED editor, netlister interface, and generic parts library. Aegis operating system. For Electronic CAE applications.
Design Station	Apollo	1,280 x 1,024	Includes all Capture Station capabilities, DOC documentation preparation, and QuickParts parametric parts library. Remote logic and timing simulation available. For Electronic CAE applications.
Idea Station	Apollo	1,280 x 1,024	Includes all Design Station capabilities, plus QuickSam logic simulation and QuickTime timing simulation. QuickFault fault simulation is optional. For Electronic CAE applications.
Chip Station	Apollo	1,024 x 800	Includes ChipGraph interactive layout, schematic editing, and documentation. Dracula II layout verification and mask data preparation is optional. For custom IC layout.

(Continued)

Table 3 (Continued)

Mentor Graphics Products

TECHNICAL WORKSTATIONS (Continued)

Model (IDEA Series)	Manufacturer	Resolution	Description
Cell Station	Apollo	1,024 x 800	Includes color Design Station functions, plus CellGraph interactive layout. Cellplace/ Cellroute automatic place/route and Dracula II DRC/ERC and mask data are optional. For cell-based IC layout applications.
Gate Station	Apollo	1,024 x 800	Includes all features of 16-color Design Station (except the parametric parts library) plus Gategraph interactive layout. Options: Gateplace and Gateroute automatic gate array place and route. For gate array IC layout applications.
Board Station	Apollo	1,024 x 800	Includes color Design Station functions plus PACKAGE, LAYOUT, and AUTOLINK for selecting component packages and interactive/automatic place and route; FABLINK photoplot and drill output; and LIBRARIAN general-purpose editor. For PCB layout applications.

APPLICATION-SPECIFIC HARDWARE

Model	Description
Compute Engine	Accelerator manufactured by Mentor which can be installed in any IDEA series workstation. 10-mip parallel processor on two-board set; can be accessed via network.

APPLICATION SOFTWARE

Model	Platform	Segment	Description
IDEA, Entry Station	PC	Electronic CAE	Schematic capture package for IBM PC. Bidirectional communication with Mentor's Apollo-based systems is included.
IDEA, Hardware Modeling Library	Technical Workstation	Electronic CAE	Simulates LSI and VLSI components, including 80386 and 68020. Functions include logic simulation. Runs on Design Station.
IDEA, MSpice	Technical Workstation	Electronic CAE	Circuit simulation package based on Berkeley Spice 2G-6. Options include MSpice Plus, an enhanced version of MSpice; a 920-component analog library for MSpice Plus; and a separate analog simulator, MSimon (for digital MOS design). Runs on Design Station.

Source: Dataquest
June 1987

CAD PRODUCT DESCRIPTION

Price: $13400

Model: IDEA, Capture Station
Type: Technical Workstation System for Electronic CAE Applications

System Configuration:

Manufacturer: Apollo
Operating System: Aegis
Communication Protocols: Domain, Ethernet
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 8 Mbyte at an increase of $4000
Expandable to 380 Mbyte at an increase of $10500

Workstation Configuration:

Manufacturer: Apollo
1024 x 800 resolution. Monochrome
Upgrade description: $9000 for 16-color. 1280 x 1024 resolution available

CAD Application Software:
schematic capture

Comments:
Based on Apollo Series 3000; $10,000 in volume. Available on DN570A and Series 4000. Includes DBMS, NETED editor, netlister interface, and generic parts library.

8705-2015-0641 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $20400

Model: IDEA, Design Station
Type: Technical Workstation System for Electronic CAE Applications

System Configuration:

Manufacturer: Apollo
Operating System: Aegis
Communication Protocols: Domain, Ethernet
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 32 Mbyte at an increase of $28000
Expandable to 380 Mbyte at an increase of $10500

Workstation Configuration:

Manufacturer: Apollo
1024 x 800 resolution. Monochrome
Upgrade description: add $9,000 for 16-color. Resolution up to 1280 X 1024 available

CAD Application Software:
schematic capture, technical publications

Language used: Pascal, C

Comments:
Based on Apollo Series 3000; available on Series 4000. Remote logic and timing simulation available. Includes all Capture Station capabilities, DOC documentation preparation, and QuickParts parametric parts library

8705-2015-0642 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $29900

Model: Idea Station
Type: Technical Workstation System for Electronic CAE Applications

System Configuration:

Manufacturer: Apollo
Operating System: Aegis
Communication Protocols: Domain, Ethernet
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 32 Mbyte at an increase of $28000
Expandable to 380 Mbyte at an increase of $10500

Workstation Configuration:

1024 x 800 resolution. Monochrome
Upgrade description: add $9,000 for 16-color. Resolution up to 1280 x 1024 available

CAD Application Software:
schematic capture, logic simulation, fault simulation
technical publications, circuit simulation, behavioral simulation
analog, schematics/diagrams

Language used: Pascal, C

Comments:
Based on Apollo Series 3000; $54,000 in volume on Series 4000 with 170 MB drive. Price includes Design Station capabilities, plus logic simulation and timing verification. QuickFault fault simulation is $16,000 additional. Analog and behavioral simulation optional.

0705-2015-0643 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $62900

Model: IDEA, Chip Station
Type: Technical Workstation System for IC Layout Applications

Date of product introduction: 12/84

System Configuration:

Manufacturer: Apollo
Operating System: AEGIS
Communication Protocols: Domain, Ethernet
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 32 Mbyte at an increase of $28000
170 Mbyte disk memory included. Expandable to 380 Mbyte at an increase of $6000

Workstation Configuration:

Manufacturer: Apollo
1024 x 800 resolution. 16 displayable colors

CAD Application Software:

IC custom, DRC/ERC, schematic capture
technical publications

Comments:

Based on Series 3000; Series 4000 starts at $85,200 in volume. Available on DN570A. Includes schematic editing. Dracula II layout verification and mask data preparation begins at $38,000; Remidi, a debugging aid, begins at $14,900.

8705-2016-1406 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $62900

Model: IDEA, Cell Station
Type: Technical Workstation System for IC Layout Applications

System Configuration:

Manufacturer: Apollo
Operating System: AEGIS
Communication Protocols: Domain, Ethernet
Microprocessor: 68020
Word size: 32
4.0 Mbyte main memory included. Expandable to 32 Mbyte at an increase of $28000
170 Mbyte disk memory included. Expandable to 380 Mbyte at an increase of $6000

Workstation Configuration:

Manufacturer: Apollo
1024 x 800 resolution. 16 displayable colors

CAD Application Software:
IC cell based, schematic capture, technical publications
DRC/ERC

Comments:
Based on Series 3000; available on DN570A and Series 4000. Includes interactive layout and color Design Station. System with auto place/route: $129,900 on Series 3000; $166,900 on DN570T. Editor, Dracula II DRC/ERC and mask data option: $55,000. $14,900 for Remidi, a graphic Dracula II debugger.

8705-2016-1405 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $51900

Model: IDEA, Gate Station
Type: Technical Workstation System for IC Layout Applications

System Configuration:

Manufacturer: Apollo
Operating System: AEGIS
Communication Protocols: Domain, Ethernet
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 32 Mbyte at an increase of $28000
170 Mbyte disk memory included. Expandable to 380 Mbyte at an increase of $6000

Workstation Configuration:

Manufacturer: Apollo
1024 x 800 resolution. 16 displayable colors

CAD Application Software:
IC gate array, technical publications, schematic capture

Comments:
Based on Series 3000; available on Series 4000 and DN570A. Includes features of 16-color Design Station (except parametric parts library) plus Gategraph interactive layout. Options: Gateplace and Gateroute automatic gate array place and route

8705-2016-1404 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $73900

Model: IDEA, Board Station
Type: Technical Workstation System for PCB Layout Applications

System Configuration:

Manufacturer: Apollo
Operating System: AEGIS
Communication Protocols: Domain, Ethernet
Microprocessor: 68020 Coprocessor: 68881
Word size: 32
4.0 Mbyte main memory included. Expandable to 32 Mbyte at an increase of $28000
170 Mbyte disk memory included. Expandable to 380 Mbyte at an increase of $5000

Workstation Configuration:

Manufacturer: Apollo
1024 x 800 resolution. 16 displayable colors

CAD Application Software:
PCB layout, surface mount design, numerical control
technical publications

Comments:
Based on Series 3000. Series 4000 starts at $85,000 in volume. Includes color Design Station functions plus PACKAGE, LAYOUT, and AUTOLINK for selecting component packages and interactive/automatic place and route; FABLINK photoplot and drill output; and LIBRARIAN general purpose editor

8705-2816-1407 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $36900

Model: IDEA, Compute Engine
Type: Accelerator System for Electronic CAE Applications

System Configuration:

Manufacturer: Mentor Graphics
Operating System: Prop.
Communication Protocols: Domain
Microprocessor: prop.
Word size: 64
10.0 Mbyte main memory included. Expandable to 192 Mbyte at an increase of $20000

Prerequisites:
Mentor Graphics software release 5.2 or later

Comments:
10–mip parallel processor board plus memory board. Can be installed in a DN570A workstation or attached via Multibus interface to DN500 and DN600 Series workstation, or via AT bus to Series 3000 or 4000 workstations.
Options: memory expansion boards.

8705-2015-0653 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $1995

Model: IDEA, Entry Station
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: PC
Date of product introduction: 3/86

CAD Application Software:
schematic capture

Language used: C

Prerequisites:
IBM PC AT

Comments:
Bidirectional communication with Mentor's Apollo-based systems is included. Also performs local plotting and netlisting.

8705-2014-5853 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $44800

Model: IDEA, Hardware Modeling Library
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

System Configuration:

Manufacturer: Mentor Graphics

Communication Protocols: Multibus
Microprocessor: 80186

2.0 Mbyte main memory included.

CAD Application Software:
logic simulation

Prerequisites:
Design Station. Host workstation must have Multibus

Comments:
Simulates LSI and VLSI components, including 80386 and 68020. Provides utilities to create models for VLSI components. May be accessed via network.

8705-2016-0948 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $9900

Model: IDEA, MSPICE
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

CAD Application Software:
analog, circuit simulation

Language used: Pascal

Prerequisites:
Design Station or Idea Station

Comments:
Based on Berkeley Spice 2G–6.

8705-2016-0750 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $19800

Model: IDEA, MSPICE PLUS
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

CAD Application Software:
analog, circuit simulation

Language used: C

Prerequisites:
Design Station or Idea Station

Comments:
Based on an enhanced version of Spice (Berkeley 3A.7); also available as an upgrade to MSPICE. A 920-component analog library is available for $20,000 first copy, $2,000 additional copies.

8705-2016-0751 MENTOR GRAPHICS

CAD PRODUCT DESCRIPTION

Price: $23800

Model: IDEA, MSIMON
Type: CAD Application Software for Electronic CAE Applications
Hardware Platform: Technical Workstation

CAD Application Software:
analog, circuit simulation

Language used: C

Prerequisites:
Design Station or Idea Station

Comments:
For digital MOS design. Also available as upgrade to MSPICE.

8705-2016-0752 MENTOR GRAPHICS

Mentor Graphics Corporation

Mentor Graphics Corporation
8500 SW Creekside Place
Beaverton, Oregon 97005
Telephone: (503) 626-7000
(Millions of Dollars Except Per Share Data)

Balance Sheet (December 31)

	1981	1982*	1983*,**
Working Capital	N/A	$1.97	$ 4.48
Long-Term Debt	$0.09	$0.24	$ 0.12
Shareholders' Equity	$0.34	$2.70	$ 9.48
After-Tax Return on Average Equity (%)	N/M	N/M	N/M

Operating Performance (Fiscal Year Ending December 31)

	1981	1982*	1983*,**
Revenue	$0.00	$1.73	$14.26
Cost of Revenue	$0.00	$0.90	$ 8.25
R&D Expense	$0.43	$1.03	$ 1.79
SG&A Expense	$0.17	$1.87	$ 5.40
Pretax Income	($0.60)	($2.07)	($ 1.17)
Pretax Margin (%)	N/M	N/M	N/M
Effective Tax Rate (%)	N/M	N/M	N/M
Net Income	($0.56)	($1.93)	($ 1.08)
Average Shares Outstanding (Millions)	N/A	0.40	2.37
Total Employees	N/A	N/A	167

N/A = Not Available
N/M = Not Meaningful
*Financial information for 1982 and 1983 is pro-forma and includes data for California Automated Design, Inc.
**Data are for the first nine months of 1983 ending September 30.

Source: Mentor Graphics Corporation
December 1983 Prospectus

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Mentor Graphics Corporation

THE COMPANY

Background

Mentor Graphics Corporation designs, manufactures, markets, and services electronic design automation (EDA) products for use in the design, analysis, physical layout, and testing of complex electronic circuits.

Mentor was incorporated in Oregon on April 2, 1981. The Company issued its preliminary prospectus on December 1, 1983, pursuant to its initial public offering expected to occur in January 1984 upon the Securities and Exchange Commission's approval.

Mentor is a spin-off from nearby Tektronix, Inc.; Mentor's founders--Thomas Bruggere, president; Gerard Langler, vice president of marketing; Stephen Swerling, vice president of engineering; and David Moffenbeier, vice president of finance and administration--were all previously employed by Tektronix in various capacities.

Mentor entered into an agreement and plan of merger on October 25, 1983, with California Automated Design, Incorporated (CADI). Under the terms of the agreement, CADI will be merged into Mentor, leaving Mentor as the surviving corporation. The merger is expected to be consummated in December 1983. CADI began operations on January 20, 1982, and is located in Santa Clara, California. CADI develops and markets software for semicustom circuit design. Mentor had entered into a previous license agreement with CADI to market certain CADI software.

Operations

Mentor's strategy is to provide the electronic designer with an integrated set of productivity tools to accelerate the process of developing electronic products and to facilitate design creativity and innovation. The Company was involved with product development from its inception in April 1981 until December 1982. Production shipments of its EDA product, the IDEA 1000, began in November 1982. Mentor has expanded its potential position in the EDA market by providing not only a logic design system, but by also offering logic and circuit simulation, physical layout of semicustom circuits, test and measurement capabilities, document preparation, and electronic mail.

Mentor operates out of two leased buildings in Portland, Oregon, with a total of approximately 25,000 square feet. The Company has entered into a new lease agreement and will be moving in January 1984 to new headquarters in Beaverton, Oregon. The new building has approximately 65,000 square feet.

Mentor maintains nine sales and training centers in the United States. The sales offices are located in Albuquerque, New Mexico; Boston, Massachusetts; Dallas, Texas; Fort Lee, New Jersey; Irvine, California; Minneapolis, Minnesota; Orlando, Florida; and San Jose, California. The training centers are located in Boston, Dallas, Portland, and San Jose.

As of September, the Company employed 167 people, of which 53 were engaged in research and development, 73 in sales marketing and support, 30 in administration, and 11 in operations. Mentor maintains a one-to-one ratio of application engineers to sales people.

International Operations

Mentor's two European subsidiaries, Mentor Graphics (U.K.) Limited and Mentor Graphics (Deutschland) GmbH, began operations in June and September, 1983, respectively. Mentor's Japanese distributor, Marubeni Hytech, was selected in April 1983 and has so far accounted for approximately $1.6 million, or 11 percent of Mentor's revenue through the first nine months of 1983.

Research and Development

Mentor is a turnkey EDA company. Its products are based on computers from Apollo Computer, Inc., and as such, Mentor's value-added and primary research and development emphasis are its applications software.

Table 1 indicates Mentor's R&D expenses as a percentage of revenue for fiscal years 1981 and 1982, ending December 31, and for the first nine months, ending September 30, of 1983. The nine months ended September 30, 1983, include CADI's revenue and R&D expenses. R&D expenses as a percent of 1981 and 1982 revenue are unusually high because, as was previously noted, Mentor was involved with product development at that time.

Mentor states that current product development plans include fault simulation software and physical layout software for standard cells and custom integrated circuits.

Mentor Graphics Corporation

Table 1

RESEARCH AND DEVELOPMENT EXPENSES*
(Thousands of Dollars)

	1981	1982	1983
Revenue	$ 0	$1,695	$14,265
R&D Expense	$426	$ 634	$ 1,786
R&D Expense as a Percentage of Revenue	N/M	37%	13%

*Data for 1981 and 1982 include Mentor Graphics Corporation only; 1983 includes Mentor and CADI.
N/M = Not Meaningful

Source: Mentor Graphics Corporation Prospectus

SYSTEMS

Mentor's IDEA 1000 line of EDA Systems are based on the Apollo DOMAIN product line. Mentor offers a wide variety of configurations differing in CRT size, memory, and disk drive capacity, but all are based on either the DN300 or the recently announced DN460. Prices for the basic configurations range from $29,900 to $79,900, including software. As of September 30, 1983, Mentor had placed approximately $16 million worth of orders with Apollo for computers to be delivered through June 30, 1984. Mentor does, however, have the right to cancel these orders. DATAQUEST estimates that Mentor is currently shipping approximately 50 systems per month.

In November 1983, Mentor announced its MIDAS 7000, which is a logic analyzer integrated into the IDEA 1000 line of design and analysis systems. Mentor has an agreement with Northwest Instrument Systems, Inc., to use some of that company's software and hardware in the MIDAS product.

Mentor Graphics Corporation

APPLICATIONS

Design Creation

Mentor packages three programs that allow the engineer to design electrical schematics. The SYMBOL EDITOR allows the design engineer to create the graphical representation and electrical attributes of a circuit element. The NETWORK EDITOR allows the engineer to connect the graphic representation of circuit elements together to form a schematic diagram. The DESIGN TRAVERSER allows the engineer to view the design hierarchy, even if portions of the design are on other workstations. Mentor's software takes full advantage of Apollo's windowing capabilities and UNIX operating system.

Design Analysis

Mentor's DESIGN EXPANDER program extracts hierarchical data from the schematic for input to the INTERACTIVE SIMULATOR and TIMING VERIFIER design analysis programs, all sold by Mentor. The Company has also modified the Berkeley-developed SPICE circuit simulator program into an interactive version that is sold on the IDEA.

Physical Layout

As a result of a previous licensing agreement with CADI and the subsequent Mentor-CADI merger, Mentor sells CADISYS gate array placement and routing software. CADISYS is available in three separate modules--CADIPLACE, CADIROUTE, and CADIGRAPH. Prior to October 1983, Mentor sold CADISYS only for mainframes that could handle up to 10,000 gates. Since October, Mentor has also offered CADISYS on its IDEA 1000 workstation for arrays of up to 2,500 gates.

Testing

In November 1983, Mentor introduced the MIDAS-7000 logic and timing analysis product used to test hardware prototypes. MIDAS tests the prototype circuit based on the same stimuli used for the logic simulation design analysis programs. In this manner, the actual physical circuit is compared to the design for completeness and soundness.

Document Preparation and Electronic Mail

In addition to addressing the design needs of the engineer, the IDEA 1000 also has administration tools such as word processing and electronic mail. The document preparation package has features such as automatic outline and page numbering that makes it more than simple text processing. It also has the ability to merge text with the current revision of graphic circuit representations, thus making it a technical publications system.

LIBRARIES

In order to facilitate process-dependent semicustom (gate array or standard cell) designs, Mentor has formed agreements with several integrated circuit manufacturers. Such agreements allow a user of Mentor's IDEA 1000 to perform the front-end logic design functions of a semicustom circuit with a specific IC manufacturer's design parameters. The user then has the choice of sending a netlist extracted from Mentor's design data base to the IC manufacturer for physical layout and final simulation, or to complete the physical layout in-house using CADISYS placement and routing software.

As of October 1983, Mentor had formal agreements with American Microsystems, Array Technology, International Microcircuits, International Microelectronics, LSI Logic, National Semiconductor, and Texas Instruments. Mentor has an informal agreement with Motorola, and is developing agreements with California Devices, Fairchild Camera and Instrument, and Plessey Semiconductor.

In addition to LSI Logic's formal agreement with Mentor, LSI Logic uses the IDEA 1000 as the front-end design system in its design centers.

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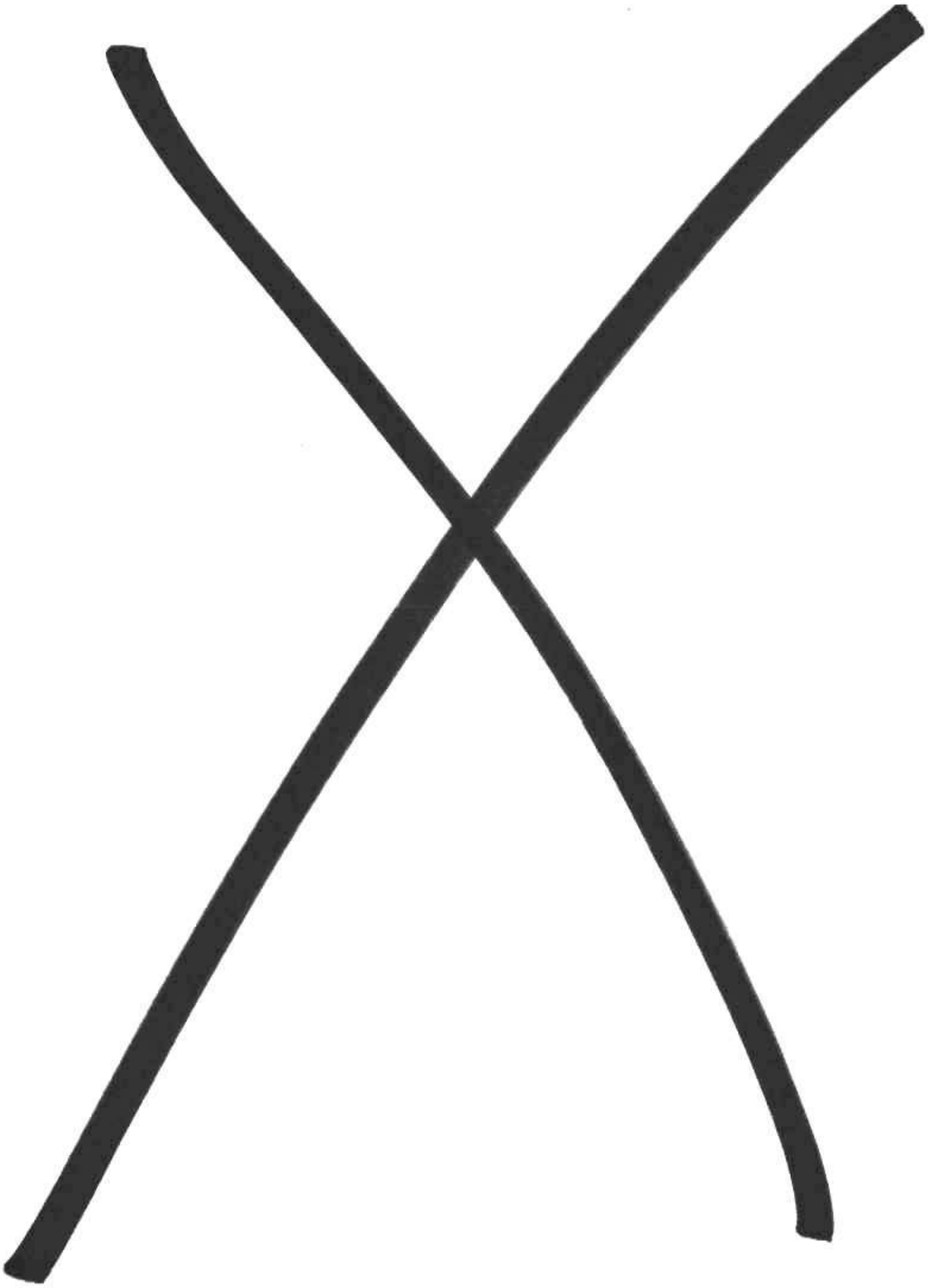


PDA Engineering

PDA Engineering Incorporated
1560 Brookhollow Drive
Santa Ana, California 92705
Telephone: (714) 556-2800
(Thousands of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF June 30

	1982	1983	1984	CAGR 1982-84
BALANCE SHEET DATA				
Working Capital	$ 573.0	$ 824.0	$ 709.0	11.2%
Long-Term Debt	$ 0.0	$ 0.0	$ 0.0	N/M
Shareholder's Equity	$1,733.0	$3,074.0	$ 4,299.0	57.5%
After-Tax Return on Average Equity	N/A	0.1%	0.1%	N/A
OPERATING PERFORMANCE				
Revenue	$4,986.9	$6,833.0	$11,232.4	50.1%
U.S. Revenue	$4,861.9	$6,558.0	$10,572.4	47.5%
Non-U.S. Revenue	$ 125.0	$ 275.0	$ 660.0	129.8%
Expenses	$4,768.9	$6,263.2	$10,091.8	78.7%
Cost of Revenue	$3,968.0	$5,084.0	$ 7,535.8	37.8%
R&D Expenses	$ 114.0	$ 277.3	$ 771.7	160.2%
SG&A Expense	$ 686.9	$ 901.9	$ 1,784.4	61.2%
Operating Income	$ 218.1	$ 569.8	$ 1,140.6	128.7%
Interest Income	$ 122.4	$ 155.9	$ 136.3	5.5%
Other Income	$ 0.0	$ 45.0	$ 68.5	N/A
Other Expenses	($0.9)	($35.8)	($17.5)	346.9%
Income before Tax	$ 339.6	$ 734.9	$ 1,327.8	97.7%
NOTE: Pretax Margin	6.8%	10.8%	11.8%	31.7%
Taxes	$ 121.8	$ 340.3	$ 373.4	75.1%
NOTE: Effective Tax Rate	35.9%	46.3%	28.1%	(11.4%)
Net Income after Tax	$ 217.8	$ 394.7	$ 954.4	109.3%
SHAREHOLDER DATA				
Average Shares Outstanding (Millions)	3.2	3.2	3.2	1.1%
Per Share Data				
Earnings	$ 0.15	$ 0.43	$ 0.27	34.2%
Dividends	$ 0.00	$ 0.00	$ 0.00	N/M
Book Value	$ 545.14	$ 955.55	$1,323.18	55.8%
Total Employees	76	87	107	18.7%
Revenue per Employee	$ 65.6	$ 78.5	$ 105.0	

Source: PDA Engineering Prospectus
DATAQUEST

PDA Engineering

PDA Engineering Incorporated
1560 Brookhollow Drive
Santa Ana, California 92705
Telephone: (714) 556-2800

LINE ITEMS AS A PERCENT OF REVENUE

	1982	1983	1984
OPERATING PERFORMANCE			
Revenue	100.0%	100.0%	100.0%
United States	97.5%	96.0%	94.1%
Non-United States	2.5%	4.0%	5.9%
Expenses			
Cost of Revenue	79.6%	74.4%	67.1%
R&D Expense	16.1%	17.3%	22.8%
SG&A Expense	13.8%	13.2%	15.9%
Operating Income	4.4%	8.3%	10.2%
Interest Income	2.5%	2.3%	1.2%
Other Income	0.0%	0.7%	0.6%
Other Expense	.0%	(0.5%)	(0.2%)
Income before Tax	6.8%	10.8%	11.8%
Taxes	2.4%	5.0%	3.3%
Net Income after Tax	4.4%	5.8%	8.5%

Source: PDA Engineering Prospectus
DATAQUEST

PDA Engineering

THE COMPANY

Background

PDA Engineering (PDA) was founded and incorporated in 1972 in Santa Ana, California, as Prototype Development Associates. PDA designs, develops, and markets software for mechanical computer-aided engineering (MCAE) applications, and provides consulting services for advanced mechanical engineering applications. In the MCAE marketplace, PDA is best known for its development of the PATRAN engineering graphics system. PATRAN was originally developed by PDA's engineers for the Company's own use in providing mechanical engineering services.

PDA had an initial public offering of its common stock during January 1985. The opening price for its stock was reported at $7-1/4 per share, and sold in excess of one million shares. PDA reported revenues totaling $11.2 million for fiscal year 1984, which ended June 30. DATAQUEST estimates that PDA's calendar year 1984 revenues totaled approximately $13 million.

This profile discusses the business of PDA's Software Products Division and aspects of its Engineering Services and Products Division.

Highlights

PDA has experienced significant growth in the area of third-party relationships for its PATRAN product. The Company views this strategy as a positive direction in addressing the issue of systems integration. The following highlights reflect PDA's direction during 1984:

- January 1984--PDA formed the Software Products Division under the direction of Louis Crain.

- January 1984--The Software Sales and Marketing Department was formed under the direction of Tony Glinskas.

- May 1984--PDA announced Release 1.6 of PATRAN, which included expanded solids modeling features and interactive menu-driven capabilities.

- July 1984--MacNeal-Schwendler Corporation (MSC) signed a licensing agreement with PDA to market the PATRAN system to customers of the MSC/NASTRAN CAE system.

- August 1984--PDA announced support of the PATRAN product for Hewlett-Packard's HP 9000 product line.

- September 1984--PDA opened its Reston, Virginia, office to serve as the regional office for PDA's East Coast operations.

- December 1984--PDA acquired the assets of Schaeffer Analysis, Inc., a company specializing in the MCAE training field. Dr. Harry Schaeffer was assigned management responsibility for future courseware.

Organization

PDA Engineering conducts most of its operations from its Santa Ana headquarters. These operations include R&D, manufacturing, marketing, sales support, training, engineering services, and administrative functions. Other PDA offices are located in different regions of the country for additional sales and support activities.

The Company's headquarters are located in a 38,000-square-foot building in Santa Ana, California. PDA leases an additional 18,000 square feet of space in which laboratory, machine shop, manufacturing, assembly, and test activities are conducted.

PDA currently employs 107 persons. Table 1 lists the number of employees by functional department.

Table 1

PDA Engineering
EMPLOYEES BY FUNCTIONAL DEPARTMENT

Engineering	53
Manufacturing	6
Marketing	4
Sales	4
Support/Pre-Sales	4
Office/Clerical	27
Administrative	9

Source: PDA Engineering

Research and Development

Table 2 lists PDA's R&D expenses, including R&D as a percent of revenue and dollars per employee for the past three consecutive fiscal years.

Several major programs have dominated the forefront of software development at PDA. They are as follows:

- Adaptation of the PATRAN system to other computer systems and graphic devices
- Development of design and analysis modules for use within PATRAN
- Expansion of PATRAN's capacity to interface with analytical modules developed by other companies

Release 1.6 of PATRAN features some of the results of this development work. In addition to expanded solids modeling capabilities, PDA also added a finite element solution system to PATRAN, permitting users to perform solid geometry modeling, finite element modeling, analysis, results evaluation, and imaging--all from within PATRAN.

PDA also completed work on a new composites design and analysis system that it will begin marketing in 1985.

PATRAN's interfaces to external programs has been expanded. Programs include NASTRAN, ANSYS, ABAQUS, and MARC, as well as the IGES standard. (Details on expansion are not available at this time).

PDA expects to continue making significant investments to expand and enhance the capabilities of the PATRAN program.

Table 2

PDA Engineering
RESEARCH AND DEVELOPMENT EXPENSES

	Fiscal Year Ending June 30		
	1982	1983	1984
R&D Expenses*	$ 114	$ 278	$ 772
Percent of Revenue	2.3%	4.1%	6.9%
Dollars Per Employee	$1,500	$3,195	$7,495

*Includes R&D expenses for Software Products Division and Engineering Services Division--(thousands of dollars)

Source: PDA Engineering

Manufacturing

PDA engages in limited manufacturing of specific products. Two products currently being manufactured are airborne stores, which are externally mounted aircraft equipment, and thermal insulation for oil drilling equipment.

Table 3 lists the 1983 and 1984 revenues realized by sales of these two products.

Table 3

PDA Engineering
MANUFACTURED PRODUCTS AND RELATED REVENUES

	Fiscal Year Ending June 30	
	1983	1984
Airborne Stores	$981,000	$419,000
Thermal Insulation	$403,000	$562,000

Source: PDA Engineering

Marketing and Sales

PDA licenses its software products to customers on a renewable annual basis. The average annual license fee is approximately $14,000. License fees, however, are not the only source of revenue for the Software Products Division of PDA. Table 4 identifies the four sources of revenue in the Software Products Division for the past three fiscal years.

PDA markets its software through three primary channels: direct sales, joint marketing agreements with leading hardware vendors, and third-party distributors.

The U.S. direct sales function is conducted through two regional offices located in Santa Ana, California, and Reston, Virginia. There are satellite offices in the San Francisco Bay Area and in Connecticut, which report to the Santa Ana office and the Reston, Virginia, office, respectively. There are four PDA salespersons, one in each location.

Table 4

PDA Engineering
SOFTWARE PRODUCTS DIVISION:
REVENUE SOURCES
(Thousands of Dollars)

Revenues	Fiscal Year Ending June 30 1982	1983	1984
License Fees	$ 860	$1,171	$2,504
Funded Software Development	83	315	811
Training Fees	75	187	280
Computer Time Sales	218	345	353
Total	$1,236	$2,018	$3,948

Source: PDA Engineering

Another key element of PDA's marketing strategy has been to supplement the selling efforts of its own sales force with efforts by third parties, including hardware manufacturers; software vendors; traditional system suppliers, including computer companies; and service bureaus. Companies currently holding licenses to sell PATRAN in the United States include Digital Equipment Corporation, Control Data Corporation, MacNeal-Schwendler Corporation, Matra Datavision, and Cray Research. DATAQUEST expects further expansion in the base of companies licensed to sell the PATRAN program. In addition, PDA has cooperative marketing agreements with most of the manufacturers of computers, interactive graphics terminals, and workstations on which PATRAN operates.

PDA's non-U.S. distributors are as follows:

- Continental Europe--Pisces International, b.v., The Netherlands
- United Kingdom/Scandinavia--Kins Developments, Ltd., England
- Japan--Rikei Corporation, Tokyo, Japan

PDA Engineering

In addition to the distributors listed, PDA recently extended its licensing agreement with Digital Equipment to include sales of PATRAN in the Far East and Japan.

Revenues realized from sales in the non-U.S. markets currently represent approximately 25 percent of total software revenues.

Marketing and sales activities in PDA's Engineering Services and Products segment are conducted principally by the Company's 11 program managers. PDA has maintained a contractual relationship with several of its customers since its inception. The largest single contract is with a government defense agency for which PDA has conducted technical activities since 1972.

Table 5 shows the revenues derived from the Software Products Division and Engineering Services and Products Division. Software product sales as a percent of total revenue continues to gain momentum. At the three months ended September 30, 1984, the Software Products Division's revenue represented 40.5 percent of PDA's total revenue.

Table 5

PDA Engineering
REVENUES BY SEGMENT
(Thousands of Dollars)

	Fiscal Year Ending June 30					
	1982		1983		1984	
	Amount	Percent	Amount	Percent	Amount	Percent
Software Products	$1,236	24.8%	$2,018	29.5%	$3,946	35.1%
Engineering Services and Products	$3,751	75.2%	$4,815	70.5%	$7,286	64.9%

Source: PDA Engineering

Training and Support

PDA provides pre- and post-sales technical support, as well as a formal training program. The software and engineering personnel located at PDA's headquarters are available to customers through a toll-free hotline to answer questions regarding the use of PDA software systems.

Instruction for new customers on the use of PATRAN takes place in three-day training sessions, which are held at PDA's Santa Ana headquarters for U.S. customers, or at Pisces International in the Netherlands, for non-U.S. customers. Payment of an initiation fee by the customer entitles two representatives to attend a training session. For an additional charge, customer representatives can attend other training sessions held monthly on subjects that range from basic PATRAN use to advanced analytical techniques. An eight-hour video tape training course, supported by workbooks and a study guide, is also available.

PDA's recent acquisition of Schaeffer Analysis, Inc. (December 1984), which specializes in mechanical CAE training, and the hiring of Dr. Harry Schaeffer as Director of Training, is a further indication of the Company's commitment to customer training. PDA has indicated that several additions and changes in its training program will take place as a result of the Schaeffer Analysis acquisition. The changes include expanding the number of training programs offered at the Santa Ana offices, and the addition of training programs to the East Coast regional sales office (approximately five or six per year). Training programs in areas other than Finite Element Modeling will also be added.

With the exception of the Cray and CDC Cyber, all of the equipment on which PATRAN operates is installed at PDA headquarters. The equipment is used for customer training and support.

MAJOR HISTORICAL MILESTONES

Listed below are PDA's major milestones since its founding:

- 1972--Company founded and incorporated as Prototype Development Associates to provide advanced technology engineering services primarily to the aerospace and defense industries
- 1977--Prototype Development Associates commenced the development of a CAE software system for mechanical design and analysis to use in its consulting services

- November 1979--PDA introduced PATRAN, the MCAE system used in-house for consulting services, as a commercial product

- July 1983--PDA entered into a joint venture agreement with Global High Energy Systems, Inc., a Texas corporation, for the purpose of producing and marketing a severing tool for deep oil wells

- July 1983--PDA acquired Western Engineering Software Service Company, Inc. (WESSCO), previously the Company's exclusive domestic PATRAN distributor

- November 1983--PDA announced the PDA/ACORN product offering at Autofact V in Anaheim, California

CAD/CAM PRODUCTS

The PATRAN system can be used in most industries where a product is designed and developed. PATRAN has been used in diverse design applications for products ranging from tires and furniture to missiles, cockpit interiors, and rocket engines. PDA has been under contract with every rocket manufacturer in the United States for the past two years.

Approximately 20 percent of the PATRAN customers are in the aerospace industry, while the balance are government agencies, utilities, and petroleum production and manufacturing companies, including those that build automobiles, electronic devices, aircraft, industrial equipment, and marine structures.

Since its original offering in November 1979, PATRAN has grown and expanded in both capabilities and customer base. Table 6 lists the number of commercial PATRAN license renewals and additions at the end of each fiscal year since 1980.

PATRAN currently consists of a series of modules built on an integrated data base. It includes solids modeling, finite element mesh generation, interface to analysis programs, results evaluation, and interface to CAD systems. PATRAN is designed to be compatible with additional modules being developed by PDA as well as with analytical programs available from different companies. PDA has developed COMPOSE, a program for composite materials analysis, which is being transformed into a module for use with PATRAN. In addition, the Company has recently introduced a linear stress analysis module, known simply as stress analysis module. Over time, the Company expects to increase the number of modules available as part of the PATRAN offering.

Table 6

PDA Engineering
COMMERCIAL PATRAN LICENSES

	Fiscal Year Ending June 30				
	1980	1981	1982	1983	1984
License Renewals	0	2	19	41	91
License Additions	4	20	24	52	91
Total Number of License Agreements at End of Period	4	22	43	93	182

Source: PDA Engineering

PATRAN is designed to operate on a wide variety of computers and interactive graphics terminals and workstations. The program also interfaces to more than 25 analysis programs and with a number of CAD programs available from other sources. Table 7 lists the computers and graphics devices on which PATRAN operates. Also included in the table is a list of the interfaces and CAD systems compatible with PDA's PATRAN program.

Table 7

PDA Engineering
PATRAN PRODUCT COMPATIBILITY

COMPUTERS

Apollo DOMAIN	Data General MV family
Control Data Cybers	Harris
CRAY	Hewlett-Packard
Digital Equipment VAX family	PRIME family

GRAPHICS DEVICES (Partial Listing)

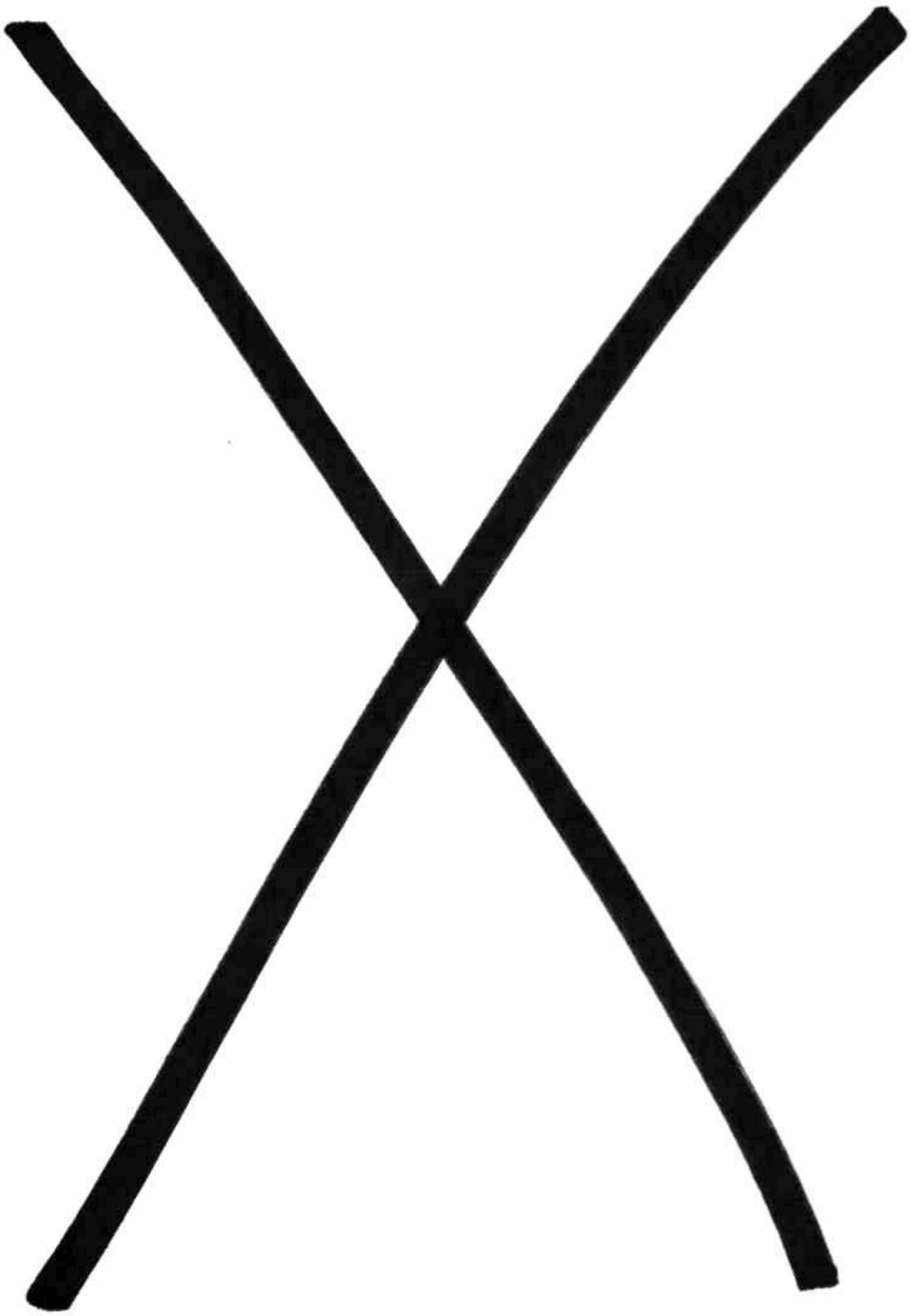
Adage	Lexidata
Advanced Electronics Design	Lundy/Sigma
Digital Engineering	Megatek
Retrographics	Ramtek
Digital Equipment Corp.	Raster Technologies
Envision	Seiko
Evans and Sutherland	Silicon Graphics
Jupiter	Tektronix

PATRAN-COMPATIBLE INTERFACES

Analysis codes:	ABAQUS	MSC/NASTRAN
	ADINA	NISA
	ANSYS	PATCHES III*
	ASAS	PISCES
	ASKA	SAAS
	COSMIC/NASTRAN	SAP
	EAL	SINDA
	EASE2*	STARDYNE
	GTSTRUDL	TEXGAP
	MARC	TRASYS
CAD Systems:	ANVIL	COMPUTERVISION
	APPLICON	EUCLID
	AUTO-TROL	MEDUSA
	CADAM	IGES
	CD2000	SDF

*Developed by PDA

Source: PDA Engineering
DATAQUEST



The Perkin-Elmer Corporation

The Perkin-Elmer Corporation
Main Avenue
Norwalk, Connecticut 06856
Telephone: (203) 762-1000
(Millions of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF JULY 31

	1979	1980	1981	1982	1983	CAGR 1979-83
BALANCE SHEET DATA						
Working Capital	$ 239.7	$ 363.0	$ 410.5	$ 418.5	$ 408.2	14.2%
Long-Term Debt	$ 55.3	$ 105.8	$ 106.3	$ 105.2	$ 53.4	(0.9%)
Shareholders' Equity	$ 282.2	$ 381.1	$ 449.8	$ 515.3	$ 482.7	14.4%
After-Tax Return on Average Equity	19.4%	20.6%	18.8%	13.0%	4.3%	N/M
OPERATING PERFORMANCE						
Revenue	$ 733.0	$ 996.2	$1,115.8	$1,036.8	$1,015.4	8.5%
U.S. Revenue	$ 467.9	$ 628.9	$ 844.6	$ 781.6	$ 743.8	12.3%
Non-U.S. Revenue	$ 265.1	$ 367.2	$ 433.6	$ 401.9	$ 402.3	0.6%
Eliminations	N/A	N/A	$ (162.4)	$ (146.7)	$ (130.7)	N/M
Expenses	$ 635.7	$ 865.4	$ 970.0	$ 933.5	$ 937.5	10.2%
Cost of Revenue	$ 411.4	$ 568.8	$ 630.9	$ 590.8	$ 587.0	9.3%
R&D Expense	$ 51.1	$ 69.8	$ 83.5	$ 80.6	$ 80.4	12.0%
SG&A Expense	$ 173.2	$ 226.9	$ 255.5	$ 262.0	$ 270.1	11.8%
Income before Tax	$ 93.2	$ 123.1	$ 145.6	$ 107.4	$ 87.7	(1.5%)
NOTE: Pretax Margin	12.7%	12.4%	13.0%	10.4%	8.6%	N/M
Taxes	$ 42.9	$ 54.9	$ 37.4	$ 44.7	$ 66.2	N/M
NOTE: Effective Tax Rate	46.0%	44.6%	25.7%	41.7%	75.5%	N/M
Net Income after Tax	$ 50.3	$ 68.2	$ 78.2	$ 62.7	$ 21.4	(19.2%)
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	39.8	41.0	43.2	43.3	43.7	2.3%
Per Share						
Earnings	$ 1.27	$ 1.67	$ 1.81	$ 1.45	$ 1.15	(2.5%)
Dividends	$ 0.25	$ 0.34	$ 0.42	$ 0.49	$ 0.50	18.9%
Book Value	$ 7.09	$ 9.30	$ 10.42	$ 11.91	$ 11.05	11.8%
Price Range (Low)	$ 9-3/4	$ 13-3/4	$ 23-1/2	$ 17-3/8	$ 17	
(High)	17	27-3/8	36-3/8	28-5/8	35-1/2	
TOTAL EMPLOYEES	13,708	15,290	15,402	14,100	14,372	1.2%

N/A = Not Available
N/M = Not Meaningful

Source: Perkin-Elmer Corporation
Annual Reports & Forms 10-K
DATAQUEST

The Perkin-Elmer Corporation
Main Avenue
Norwalk, Connecticut 06856
Telephone: (203) 762-1000

LINE ITEMS AS A PERCENT OF REVENUE

	1979	1980	1981	1982	1983
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
U.S. Revenue	63.8%	63.1%	62.9%	75.4%	73.3%
Non-U.S. Revenue	36.2%	36.9%	37.1%	24.6%	26.7%
Expenses	86.7%	86.9%	86.9%	90.0%	92.3%
Cost of Revenue	56.1%	57.1%	56.5%	57.0%	57.8%
R&D Expense	7.0%	7.0%	7.5%	7.8%	7.9%
SG&A Expense	23.6%	22.8%	22.9%	25.3%	26.6%
Income before Tax	12.7%	12.4%	13.0%	10.4%	8.6%
Taxes	5.9%	5.5%	3.4%	4.3%	6.5%
Net Income after Tax	6.9%	6.9%	7.0%	6.0%	2.1%
REVENUE PER EMPLOYEE (Millions of Dollars)	$ 0.1	$ 0.1	$ 0.1	$ 0.1	$ 0.1

Source: DATAQUEST

The Perkin-Elmer Corporation

THE COMPANY

Background

The Perkin-Elmer Corporation was founded in 1938 by Richard S. Perkin, an investment banker, and Charles W. Elmer, a retired court reporter and publisher. The Company was incorporated in New York State in 1939; its first manufacturing operations were located in New Jersey. Perkin and Elmer's interest in astronomy led to the Company's first products--high-quality astronomical telescopes and optical instruments. During World War II, Perkin-Elmer Corporation manufactured bomb sights and height finders and produced the first infrared spectrophotometer. The new spectrophotometer became the basis for the Company's analytical instrumentation business.

Perkin-Elmer moved its manufacturing operations and headquarters to Glenbrook, Connecticut, in 1942 and then moved the headquarters to Norwalk, Connecticut, in 1950.

The Company merged with Interdata, Incorporated, in July 1974. Interdata, which was founded in 1966, manufactured high-performance, general-purpose minicomputers, software, and integrated systems. In 1976, Perkin-Elmer acquired Wangco, a manufacturer of mass storage devices, including magnetic tape, cartridge disk, and floppy disk systems. In 1976, Perkin-Elmer formed its Data Systems Group, which combined products manufactured by Interdata, Wangco, and the former Perkin-Elmer Terminals Division.

CAD/CAM and Related Highlights

- In June 1984, Perkin-Elmer announced a proprietary version of the Unix System V operating system called Xelos. Xelos is scheduled for October 1984 delivery and will include AT&T's Documentor's Workbench text processing tools and command interpreter shell, the University of California at Berkeley's C shell, and Perkin-Elmer's MenuMaker.

- Also in June, the Company announced its third-party software program called Solutions to Applications Requirements Today (START). The Third-party Ventures Group within the Data Systems Group is responsible for the START program. Third-party software will be brought in-house either by acquisition or by joint marketing arrangements.

The Perkin-Elmer Corporation

- The Passport program was announced in June, whereby Perkin-Elmer announced discounts, service deals, and extended payment plans for its OEM customers.

- Perkin-Elmer fully supports industry standards through its Everyware products, which are intended to allow Perkin-Elmer products to co-exist and communicate with other vendors' product lines. The Everyware standards products include:

  - IBM SNA network
  - IEEE 802.3 Ethernet local area network
  - Unix operating system
  - ISO open systems interconnect reference model
  - CCITT X.25 switch network

Operations

Perkin-Elmer is organized into six business segments. These groups and their products are listed below. Their respective operating performance is listed in Table 1.

- Instrument Group--Instruments used for chemical and material analysis

- Data Systems Group--Computer products and related peripherals used for data processing and technical applications

- Semiconductor Equipment Group--Manufacturing equipment including projection mask aligners, step-and-repeat alignment systems, electron beam lithography, and plasma etching and sputtering products

- Optical Group--Electro-optical systems for space astronomy, laser defense, and atmospheric monitoring

- Bodenseewerk Geraetetechnik (BGT)--Avionic and missile systems for European markets

- METCO--Thermal spray technology products that coat surfaces to improve resistance to wear, heat, and corrosion

The Perkin-Elmer Corporation

Table 1

OPERATING PERFORMANCE BY BUSINESS SEGMENT
(Millions of Dollars)

	1979	1980	1981	1982	1983
Instrument Group					
Revenues	$238.8	$293.3	$328.7	$323.8	$311.5
Income before Tax	$ 32.4	$ 41.5	$ 49.2	$ 43.9	$ 32.8
Data Systems Group					
Revenues	$166.9	$210.9	$225.3	$210.6	$214.0
Income before Tax	$ 15.6	$ 24.5	$ 20.8	$ 19.0	$ 15.1
Semiconductor Equipment Group					
Revenues	$ 88.1	$150.7	$193.8	$165.0	$170.0
Income before Tax	$ 27.6	$ 32.6	$ 47.5	$ 20.9	$ 19.1
Optical Group					
Revenues	$111.5	$155.8	$162.3	$144.8	$145.4
Income before Tax	$ 10.4	$ 16.2	$ 17.6	$ 13.5	$ 13.1
Bodenseewerk Geraetetechnik					
Revenues	$ 52.7	$ 92.6	$111.5	$111.7	$107.0
Income before Tax	$ 5.7	$ 11.4	$ 11.7	$ 12.5	$ 13.8
METCO					
Revenues	$ 79.6	$100.3	$100.9	$ 86.7	$ 78.1
Income before Tax	$ 13.1	$ 16.3	$ 19.4	$ 11.2	$ 7.9

Source: DATAQUEST

In July 1982, Perkin-Elmer Electron Beam Technology, Inc., a wholly owned subsidiary of Perkin-Elmer, became part of the Company. Production of manufacturing electron beam exposure systems will be conducted by the Semiconductor Equipment Group. Also in fiscal 1982, the Terminals Division was transferred from the Data Systems Group to the Instrument Group.

The Perkin-Elmer Corporation

Sales in fiscal 1983 were $1,015.4 million, compared to $1,036.8 million in fiscal 1982, representing a decrease of 2 percent. Cost of sales also decreased, from $590.8 million in 1982 to $587.0 million in 1983. In 1983, capital expenditures were $46.6 million, compared to $46.4 million in 1981.

International Operations

Non-U.S. revenue was $402.3 million in fiscal 1983, compared to $401.9 million in fiscal 1982, or approximately 39 and 40 percent of total revenue for fiscal years 1982 and 1983, respectively.

Manufacturing facilities outside the United States are located in West Germany, the United Kingdom, the Republic of Ireland, and the Commonwealth of Puerto Rico.

Marketing

In the United States, the largest portion of Perkin-Elmer's products are distributed through direct sales forces within each business unit. Sales outside the United States are generally made by foreign sales subsidiaries, although some sales are made directly to foreign customers. In some countries, where the sales volume does not warrant a sales subsidiary, the Company uses various representative and distributorship arrangements.

Each business unit is responsible for the marketing and sales of its respective products. The Data Systems Group, which has responsibility for Perkin-Elmer's CAD/CAM products, has 30 sales offices in the United States, 32 non-U.S. sales offices, and 29 non-U.S. distributors.

Facilities

Perkin-Elmer Corporation operates out of 31 facilities comprising approximately 4 million square feet. Each of its business units operates in separate buildings located throughout the United States, the United Kingdom, West Germany, and Puerto Rico.

Research and Development

Research and development expenditures in fiscal 1983 were $80.4 million, 0.2 percent lower than the $80.6 million spent in fiscal 1982. R&D expenditures in fiscal 1983 represented 8 percent of total corporate revenues.

The Perkin-Elmer Corporation

Employees

The number of employees of Perkin-Elmer Corporation increased 2 percent during fiscal 1983 to a total of 14,372 persons. Of this number, 9,874 persons were employed in the United States and 4,498 persons were employed at the Company's non-U.S. locations, primarily in Europe.

CAD/CAM BUSINESS

Perkin-Elmer's CAD/CAM products are based on CADAM Incorporated's CADAM software products, which the Company licenses directly from CADAM. The CAD/CAM work center modules offered by Perkin-Elmer include:

- CAD-Only Module--Interactive graphics capability for the design of production drawings
- CAD/CAM Interactive Module--All capabilities of the CAD-only module, plus the ability to create and edit numerical control part programs
- 3-D Design/Surface Geometry Module--Allows the user to construct, display, and interrogate three-dimensional surface geometry
- 3-D Design/Mesh Geometry--Permits the user to construct and manipulate mesh models
- Geometry Interface Module--Graphics language to allow the user to interface directly to the data base to extract data for other programs
- Solids Modeling--Based on the solids modeler from Mathematical Applications Group Incorporated (MAGI)
- Data Management Module--A batch mode program that creates and manages CAD/CAM data files
- Hardcopy Module--Software to obtain a hard copy of a drawing on either a Benson or Versatec electrostatic plotter
- Accounting Information Module--Allocation of expenses of various accounts concerning usage of interactive modules
- Telecommunications Module--Hasp protocols allow the Perkin-Elmer CAD/CAM workstation or system to communicate with a host computer

- APT Interface Module--Automatic Part Tool (APT) interface between CAD/CAM data base and instruction sets to run machine tools

- APT Source Geometry Generator Module--Source geometry data, APT geometry list, and a labeled geometry plot for numerical control programmers

- CAD/COM II Interface Module--Translates CAD/CAM data base into COMPACT II source language

The Perkin-Elmer work center is based on the Company's 3200 Series of Megamini systems in a standalone networked environment. The system is based on 32-bit architecture and supports 2 to 8 megabytes of memory and an 80- or 300-megabyte disk drive.

A Chromatics CGC7900 display is used for the high-performance requirements of solids modeling. The CGC7900 has an MC 68000, 19-inch color display with 1,024 x 768 resolution. It is capable of displaying 256 colors simultaneously out of 16 million.

Personal CAD Systems, Inc.

Personal CAD Systems, Incorporated
981 University Avenue
Los Gatos, California 95030
Telephone: (408) 354-7193

(Personal CAD Systems, Incorporated, is a privately held company; therefore, no financial data are available.)

THE COMPANY

Background

Personal CAD Systems, Incorporated (PCAD), was formed in December 1982 in Los Gatos, California. The Company develops, markets, and supports personal computer-based software for electronic CAD/CAM applications.

Highlights

Recent Company highlights, in reverse chronological order, include the following:

- October 1985--PCAD introduced PC Drill, a software utility program supporting numerically controlled printed circuit board drilling.

  Also in October, PCAD announced the availability of a new graphics system offering 1,024 x 800 resolution on the IBM PC AT.

- September 1985--The Company signed an OEM agreement with General Electric Company (GE) whereby GE will sell PCAD's software products with its own CMOS gate array and standard cell libraries on IBM PC ATs.

- July 1985--PCAD and LSI Logic Corporation, a Milpitas, California-based supplier of CMOS gate arrays, announced the completion of a joint development project that allows users of PCAD's electronic design automation (EDA) software to create integrated circuits with LSI's array libraries.

- July 1985--The Company introduced a data base tool kit that enables users of PCAD's EDA software to move their designs to and from all existing CAE/CAD/CAM systems utilizing the PCAD Database Interchange Format (PDIF).

- July 1985--The Company announced that it had ported its PCB software to the UNIX operating system (Version 4.2) in order to expand the number of hardware options available to customers.

- June 1985--PCAD acquired Assisted Technology, Incorporated (ATI), a San Jose, California-based software company. ATI designs and sells CUPL, a programmable logic device (PLD) software package used in the semiconductor industry.

- May 1985--PCAD announced the availability of four new interfaces (SCICARDS, SPICE, Motorola software, and netlist translation to ASCII format) that allow circuit designs done on a PCAD system to be extracted and transferred to other systems.

- May 1985--The Company announced the availability of three new component libraries (CMOS Family Components Library, Microprocessor Library, and Discrete Device Components Library) and two new semicustom integrated circuit libraries (Motorola ALS-TTL Macrocell Array Library and Motorola CMOS Macrocell Array Library).

- April 1985--PCAD introduced autorouting and histogram capabilities for its PCB software, allowing users to design printed circuit boards (PCBs) from start to finish on a personal computer using automated methods.

- March 1985--The Company sold its Architectural, Engineering, and Construction (AEC) Division to the CalComp Group of Sanders Associates, an Anaheim, California-based computer graphics company.

- February 1985--PCAD unveiled several new design software products:

  - PC-NLC, a personal computer-based netlist comparison utility

  - PC-DRC, personal computer-based design rule checking software for PCB layout

  - PC-BACK, personal computer-based design software that extracts physical layout information from a PCB design and inserts the information into the design's schematic

- January 1985--The Company signed an agreement with Altera Corporation of Santa Clara, California, a manufacturer of erasable programmable logic devices (EPLDs) whereby Altera will sell a combination package with PCAD's EDA tools and their own logic design software.

Organization

Systems integration, marketing and sales, general administration, and research and development are all housed in the Company's headquarters in Los Gatos, California. The Company currently employs 123 people. Please refer to Table 1 for distribution of employees.

Table 1

Personal CAD Systems
EMPLOYEES BY DEPARTMENT

Marketing (includes support)	27
Sales	34
General/Administration	19
Research and Development	43
Total	123

Source: DATAQUEST

Marketing and Sales

PCAD primarily sells software and does not manufacture hardware. However, the Company does offer fully configured PC-based CAD systems to users who prefer to buy systems on a turnkey basis. Approximately 50 percent of the Company's customers are first-time ECAD buyers who purchase turnkey systems, and the remaining half of PCAD's customer base consists of users who already have CAD systems.

The Company's products are sold primarily through manufacturer's representatives and value-added dealers. PCAD has ten instrumentation-oriented manufacturer's representatives selling the Company's software in the United States, seven representatives in Europe, and one in the Far East. PCAD also maintains a direct sales group to deal with OEMs and other major accounts. The Company has an installed base of approximately 3,200.

PCAD's marketing strategy involves forming alliances with companies that allow PCAD users to upload to larger systems, thus expanding the Company's existing market opportunities. Please refer to Table 2 for a list of companies with which PCAD has formed strategic alliances.

Table 2

Personal CAD Systems
STRATEGIC ALLIANCES

Company	Agreement
Altera Corporation	Altera OEMs the PCAD schematics capture software for design of Altera PLDs.
Calay Systems	PCAD develops and markets a two-way interface, allowing interactive use of PCAD's and Calay's software.
General Electric	PCAD sells NX-TDL, an interface that allows users to upload PCAD logic designs to a TEGAS simulator. Also, GE markets PCAD's software with its own CMOS gate array and standard cell libraries on the IBM PC AT.
IBM	PCAD is an IBM value-added dealer, selling the IBM PC in a turnkey configuration.
Texas Instruments	Texas Instruments runs PCAD software on the TI Professional Computer.

Source: DATAQUEST

Research and Development

PCAD will maintain its open architecture approach to product development, porting its software to standalone and host-dependent systems as well as to other personal computers to maintain an upward growth path that will expand the use of its software.

The Company will continue to provide interactive and automated design solutions for implementation on the IBM PC AT, as well as improving levels of integration for existing software.

Support

PCAD provides training for customers at its Los Gatos headquarters. The Company has recently begun offering on-site customer training, and it will be opening support centers during the next fiscal quarter in the following states:

- California
- Florida
- Massachusetts
- Minnesota
- Texas

PCAD will also be opening support offices in Europe and Japan.

Training courses generally run five days in duration and include basic operation of hardware as well as utilization of software.

MAJOR HISTORICAL MILESTONES

Below is a reverse chronological list of the events that have shaped PCAD's history in the CAD/CAM Industry:

- December 1984--Total reported sales (including the AEC division) were $10 million.
- April 1984--PCAD's first product was shipped.
- December 1983--The Company received $3.5 million in first-round financing from Robertson, Coleman, Stevens; New Enterprise Associates; Crosspoint Venture Partners; and Abbingworth, Limited, of England.
- December 1983--PCAD was incorporated.
- March 1983--Crosspoint Venture Partners put up $0.5 million in seed funding.

CAD/CAM PRODUCTS

PCAD has three software product lines:

- CAE (schematic entry with or without simulation)
- CUPL (PLDs)
- PCB

See Table 3 for a further breakdown and descriptions of the Company's software products.

Table 3

Personal CAD Systems
SOFTWARE PRODUCTS

Name	Description
CAE-I	Does schematics capture with editing features such as rubberbanding and attribute maintenance for logic elements needed in simulation, as well as design rules checking
CAE-II	Includes all features of CAE-I; performs interactive, 12-level logic simulation
CUPL	Designs the logic and programs for PLDs
PCB-1	Basic PCB CAD system; includes layout and design, logic and component packaging, design rule checking, netlist extraction, and formatting
PCB-2	Includes all features of PCB-1, plus facilities for schematic capture and multisheet linking
PCB-3	Includes all features of PCB-1 and -2, plus autorouting and histogram capabilities

Source: DATAQUEST

Prime Computer, Inc.

Prime Computer, Inc.
Prime Park
Natick, Massachusetts 01760
Telephone: (617) 655-8000 Telex: 951571
(Millions of Dollars Except Per Share and Employee Data)

BALANCE SHEET (December 31)

	1981	1982	1983	1984	1985	CAGR 1981-1985
Working Capital	$ 145.8	$ 164.9	$ 203.0	$ 233.4	$ 269.9	16.5%
Long-Term Debt	$ 58.1	$ 17.2	$ 16.3	$ 16.7	$ 14.8	(29.0%)
Shareholders' Equity	$ 142.5	$ 228.9	$ 268.2	$ 325.0	$ 383.3	28.1%
After-Tax Return on Average Equity	31.2%	24.2%	13.1%	20.1%	16.3%	
OPERATING PERFORMANCE						
Revenue	$ 364.8	$ 435.8	$ 516.5	$ 642.8	$ 769.7	20.5%
U.S. Revenue	$ 221.1	$ 273.9	$ 321.8	$ 373.4	$ 411.4	16.8%
Non-U.S. Revenue	$ 143.7	$ 161.9	$ 194.7	$ 269.4	$ 358.3	25.7%
Cost of Goods Sold	$ 159.7	$ 185.7	$ 242.9	$ 301.7	$ 358.4	22.4%
Gross Margin	$ 205.1	$ 250.1	$ 273.6	$ 341.1	$ 411.3	19.0%
Expenses	$ 145.8	$ 181.5	$ 222.6	$ 267.8	$ 333.4	23.0%
R&D Expense	$ 27.5	$ 37.0	$ 52.1	$ 64.1	$ 81.8	31.3%
SG&A Expense	$ 118.3	$ 144.5	$ 170.5	$ 203.7	$ 251.6	20.8%
Operating Income	$ 59.3	$ 68.6	$ 51.0	$ 73.3	$ 77.9	7.1%
Interest Expense	$ 5.1	$ 1.3	$ 1.7	$ 1.0	$ 0.0	(100.0%)
Interest Income	$ 0.8	$ 0.0	$ 0.0	$ 0.0	$ 0.8	0.0%
Other Income (Expense)	$ 0.0	($ 2.0)	($ 1.5)	($ 2.0)	($ 1.7)	N/M
Income before Tax	$ 55.0	$ 65.3	$ 47.8	$ 70.3	$ 77.0	8.8%
NOTE: Pretax Margin	15.1%	15.0%	9.3%	10.9%	10.0%	
Taxes	$ 17.3	$ 20.4	$ 15.3	$ 10.6	$ 19.2	2.6%
NOTE: Effective Tax Rate	31.5%	31.2%	32.0%	15.1%*	24.9%	
Net Income after Tax	$ 37.7	$ 44.9	$ 32.5	$ 59.7	$ 57.8	11.3%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	$ 45.1	$ 45.5	$ 47.9	$ 47.9	$ 48.2	1.7%
Per Share Data						
Earnings	$ 0.84	$ 0.99	$ 0.68	$ 1.25*	$ 1.20	9.3%
Dividends	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	N/M
Book Value	$ 4.81	$ 5.03	$ 5.60	$ 6.78	$ 7.96	13.4%
Price Range (Low) (High)	$ 11 1/2- 32 7/8	$ 10 3/8- 25 7/8	$ 13 1/4- 30 1/4	$ 11 3/4- 21 1/2	$ 14 1/2- 23 7/8	
TOTAL EMPLOYEES	4,636	5,311	5,927	7,348	8,115	15.0%
Revenue Per Employee	$78,689	$82,056	$87,144	$87,480	$94,849	4.8%

N/M = Not Meaningful

*Includes impact of two nonrecurring credits: $9.0 million tax reversal on Domestic International Sales Corp. income, and $1.6 million Compeda goodwill writedown. Excluding the impact of these two items, earnings per share was $1.09, and the effective tax rate was 27.9 percent.

Source: Prime Computer

Prime Computer, Inc.
Prime Park
Natick, Massachusetts 01760
Telephone: (617) 655-8000 Telex: 951571

Line Items as a Percent of Revenue

	1981	1982	1983	1984	1985
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
U.S. Revenue	60.6%	62.8%	62.3%	58.1%	53.4%
Non-U.S. Revenue	39.4%	37.2%	37.7%	41.9%	46.6%
Cost of Goods Sold	43.8%	42.6%	47.0%	46.9%	46.6%
Gross Margin	56.2%	57.4%	53.0%	53.1%	53.4%
Expenses	40.0%	41.6%	43.1%	41.7%	43.3%
R&D Expense	7.5%	8.5%	10.1%	10.0%	10.6%
SG&A Expense	32.4%	33.2%	33.0%	31.7%	32.7%
Operating Income	16.3%	15.7%	9.9%	11.4%	10.1%
Interest Expense	1.4%	0.3%	0.3%	0.2%	0.0%
Interest Income	0.2%	0.0%	0.0%	0.0%	0.1%
Other Income (Expense)	0.0%	(0.5%)	(0.3%)	(0.3%)	(0.2%)
Income before Tax	15.1%	15.0%	9.3%	10.9%	10.0%
Taxes	4.7%	4.7%	3.0%	1.6%	2.5%
Net Income after Tax	10.3%	10.3%	6.3%	9.3%	7.0%

Source: Prime Computer
Dataquest
August 1986

THE COMPANY

Founded

Prime Computer, Inc., was incorporated in Delaware in 1972.

Positioning

Prime designs, manufactures, markets, and services general-purpose host computers. In early 1984, the Company entered the CAD/CAM marketplace as a bundled solution seller by acquiring marketing rights to the MEDUSA product. At year-end 1985, CAD/CAM sales represented approximately 18 percent of the Company's overall revenue.

Within the CAD/CAM marketplace, Prime's primary focus is on mechanical and AEC CAD. The Company offers a range of applications software in conjunction with its system offerings. Prime's principal software product for this market is PRIME MEDUSA.

In 1985, the Company shipped 346 systems and 1,227 workstations.

FINANCIAL

Revenue

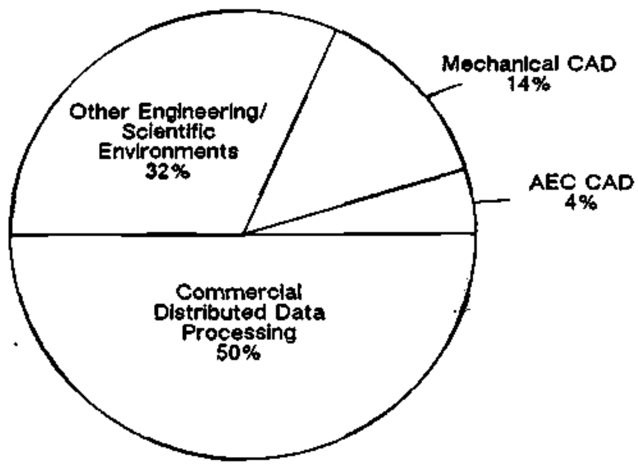
In recent years, approximately 75 percent of Prime's revenue has been derived from products, and approximately 25 percent has come from service. The Company's 1985 sales by application are shown in Figure 1.

Financing

Prime received a $1.5 million infusion of venture capital in 1972 from four sources—First Century Partnership, Idanta Partners, Paine Venture Fund, and Sutter Hill Ventures. Belgian Overseas Securities, First Century Partnership, Greylock Management, and Sutter Hill ventures provided $1.3 million in second-round financing in March 1973. The first public stock offering took place in February 1974, and it yielded $2.8 million; the underwriter was Clark Dodge. A subsequent stock offering occurred in March 1977, bringing in $4.6 million. The underwriter was Smith Barney, Harris Upham.

Figure 1

Prime Computer, Inc.
Sales by Application
1985



Source: Prime Computer
Dataquest
August 1986

HIGHLIGHTS

Listed below in reverse chronological order are highlights of the Company's most recent fiscal year:

- May 1986—Prime announced level 2B implementation of Graphical Kernel System (GKS) software, a graphics tool kit that allows users to produce and manipulate geometric shapes into two-dimensional pictures.

- April 1986—Prime announced both the 9755, which replaces the 9750, and the Mod 2 upgrade to the 9555 host computer.

- April 1986—The Company announced a marketing agreement whereby it will introduce customers to MCNET from RWT Corporation of Arlington Heights, Illinois. MCNET is a network that electronically links numerical control machines, tool presetters, and robots to a computer, eliminating punched paper tapes.

- February 1986—Prime introduced its first personal computer product, an option to its PT200 alphanumeric display terminal.

- February 1986—The Company stated its commitment to support IBM's LU6.2 peer processing communications standard. This represents a continuation of the Company's previous commitments to support key communications standards. In November 1985, Prime had announced its intention to support the MAP/TOP standard as part of an overall computer-integrated manufacturing commitment. Earlier, the Company had pledged to integrate the Ethernet local area network protocol into its network offerings.

- January 1986—The Company introduced the 2350 and 2450 host computers.

- December 1985—Prime introduced the T3350, a TEMPEST-certified host. TEMPEST certification meets the U.S. National Security Agency's standard for equipment that deals with classified information.

- November 1985—Prime announced its intention to support the MAP/TOP standard as part of an overall commitment. The Company had previously announced another commitment to communications: to integrate the Ethernet LAN protocol into its network offerings.

- October 1985—The Company introduced Management Decision Link (MDL), software that extracts parts-related data from PRIME MEDUSA drawings for use in data base management programs running on Prime's 50 Series computers. Typical applications would include cost accounting and master producting scheduling.

- October 1985—Prime introduced the 2655 and 9655 host computers.

- July 1985—The Company announced the PW153, a host-dependent workstation optimized for use with PRIME MEDUSA.

- May 1985—The Company introduced Primix, a version of UNIX System V for the 50 Series computers. Users can switch between Primix and Primos, the Company's proprietary operating system.

- May 1985—Prime announced the FM+ facility management program, offered through a licensing agreement with Micro-Vector, located in Armonk, New York.

- April 1985—The Company announced a three-year contract valued at $10 million with Raster Technologies of North Billerica, Massachusetts, for the Raster One series graphics subsystem.

- February 1985—The Company named Andrew C. Knowles Corporate Vice President, CAD/CAM Workstations and Terminals.

- January 1985—Prime announced the Prime/SNA product family, which allows Prime systems to communicate with an IBM host in an SNA network. Prime/SNA is compatible with the Primenet network.

- January 1985—The Company announced its high-end host computer, the 9955.

ORGANIZATION

Personnel Distribution

During 1985, the Company increased its worldwide direct sales force by 20 percent. Since July 1984, Prime has increased its worldwide sales force by 54 percent and its non-U.S. sales force by 70 percent. As of December 31, 1985, Prime's personnel were distributed as follows:

Department	Number of Employees
R&D/Engineering	1,315
Marketing	
United States	1,279
Non-United States	1,514
Customer Service	2,032
Other	1,975
Total Employees	8,115

Of the 8,115 total employees, 5,194, or 64 percent, are located in the United States.

Facilities

Prime occupies a 510,000-square-foot building at its Natick, Masachusetts, headquarters, which is used for administration and marketing. Other locations include:

Location	Use	Approximate Size (Square Feet)
Framingham, Massachusetts	R&D, Manufacturing, Warehousing	243,000
Coolock, Ireland	Manufacturing	146,000
Ponce, Puerto Rico	Manufacturing (board assembly)	88,000
Bedford, United Kingdom	R&D	23,000
Stevenage, United Kingdom	R&D	16,422
Canberra City, Australia	R&D	9,000

MARKETING AND SALES

Strategy

As part of a company-wide strategy, Prime has continued to upgrade its computer offerings; all of its current models have been introduced since 1984. In addition, Prime has aggressively expanded its non-U.S. sales force since July 1984; since 1976, it has maintained international sales at more than 40 percent of revenue.

Within its CAD/CAM products, the Company's primary focus is on the mechanical and AEC CAD markets. Prime offers applications software as part of its turnkey offerings and maintains a list of approximately 240 additional third-party CAD/CAM software packages, providing users with a broad range of applications software. In addition, the Company continues to develop programs for OEMs and other resellers.

Prime has stated a commitment to an open system networking philosophy and to support of national and international standards, such as MAP/TOP protocols, Ethernet, and the UNIX operating system. In addition, the Company has indicated that it will provide compatibility with key IBM standards.

Distribution

The Company's products are primarily sold directly to end users through sales offices in 83 U.S. and 64 non-U.S. locations in 50 countries. In the 30 countries where Prime does not have a wholly owned subsidiary, it sells through distributors at 45 locations. Turnkey CAD systems are sold at 40 of the U.S. sales offices and at 13 of the non-U.S. sales offices.

At year-end 1985, Prime had also signed agreements with 36 participants in its relatively new Value-Added Dealer, Value-Added Reseller, and OEM Reseller programs.

SALES SUPPORT

Warranties

Prime offers a 90-day warranty on hardware.

Maintenance Agreements

The Company maintains 222 service locations in 50 countries and a remote diagnostic service center in the United States. Maintenance services are primarily performed under contract, with various levels of service being offered by the Company:

- Basic service, offering hardware service during normal business hours and generally providing next-day service
- Deferred service, offering basic service combined with a preventive maintenance plan
- Preferred serivce, offering service between 7 a.m. and 7 p.m. on business days, a two- to four-hour guaranteed response time in metropolitan areas, and upgrades and maintenance of operating systems

Separate software maintenance and update agreements are available for minimum hardware configurations covered by a Prime hardware service contract.

Products sold by the Company's international distributors are serviced by those distributors or their agents.

Training

Prime's CAD/CAM buyers are trained in a one-week period in one of four centers in Natick, Masachusetts; Dearborn, Michigan; Stevenage, England; and Stockholm, Sweden.

STRATEGIC ALLIANCES

Joint Developments

In December 1985, Prime and CSPI of Billerica, Massachusetts, announced plans for the joint development of an array processor for the Prime 50 Series line. An array processor would provide Prime users with an alternative to mainframe computers for the high-speed calculations required in CAD/CAM applications.

Reseller Agreements

At year-end 1985, Prime had signed agreements with 36 participants in its Value-Added Reseller, Value-Added Dealer, and Original Equipment Manufacturer Programs, which were introduced in 1984 and 1985.

Joint Marketing Agreements

Prime's Application Consultant Program offers specialty software firms financial incentives for teaming up with Prime's field sales offices in selling Prime systems. This program primarily operates outside of CAD/CAM applications.

Cooperative Marketing Agreements

In April 1985, Prime announced an agreement with RWT Corporation of Arlington Heights, Illinois, where Prime will introduce customers to MCNET. MCNET is a network that electronically links numerical control machines, tool presetters, and robots to a computer, eliminating punched paper tapes.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- October 1984—Prime signed a contract with Tektronix, Inc., to sell and support several versions of the Tektronix 41XX series host-dependent workstation.

- September 1984—The Company announced the availability of Graphical Numerical Control (GNC), a software package for machine tool programming. This announcement followed a March 1984 agreement for nonexclusive worldwide marketing rights to GNC with CADCentre Limited, of Cambridge, England.

- September 1984—Prime announced the addition of the SAMMIE Program, a product of Compeda Ltd., which tests the comfort, viewing parameters, and movements of a simulated human as part of an MCAE design.

- September 1984—The Company introduced the Value-Added Reseller (VAR) and Application Consultant Programs.

- February 1984—Prime announced an agreement under which the Company purchased from Computervision Corp. joint ownership of Revision Four of MEDUSA, a mechanical drafting, design, and three-dimensional solids modeling software package. The agreement was enacted on June 1, 1984, enabling both companies to market the MEDUSA product on a worldwide basis.

- November 1983—The Company announced the PW200 32-bit graphics workstation.

- September 1983—Prime announced a marketing agreement with Logan Associates, of the United Kingdom, giving Prime exclusive worldwide marketing rights to LOCAM, a computer-aided process planning system.
- July 1983—The Company introduced the Prime 9950, an extension of the 50 Series product line. It obsoleted the Company's former highest-performance system, the 850.
- June 1983—Prime introduced the Producer 100, the first in a line of microprocessor-based workstations.
- May 1983—The Company announced a joint venture with Ford Motor Company to market the Product Design Graphics System (PDGS) software.
- February 1983—The Company announced the Authorized Distributor Program to consolidate Prime's Authorized Information Dealers, Systems Builders, and Authorized Remarketers under a single program.
- 1983—Prime began a concerted effort to offer a total CAD/CAM system solution with its hardware products as the nucleus of a packaged approach.
- 1979—The Company introduced the mainstay of its product line, the Series 50 line. Primenet, a local area network, was also announced.
- 1978—Prime was listed on the New York Stock Exchange.
- March 1977—The Company made its second public stock offering.
- 1976—International sales exceeded 40 percent of revenue for the first time.
- February 1974—The Company made its first public stock offering.
- March 1973—Prime received $1.3 million in second-round financing.
- October 1972—Prime's first product was announced, the System 200.
- 1972—Prime received a $1.5 million infusion of venture capital from Idanta Partners, First Centry Partnership, Paine Venture Fund, and Sutter Hill Ventures.

CAD/CAM PRODUCTS

Market Segment Participation

Prime supplies OEM host computers and turkney systems in the mechanical and AEC market segments.

Product Line

The Company's products are shown in Table 1. Prime's 50 Series Computers offer 32-bit architecture, offer expandable virtual memory, and can operate under either Prime's proprietary PRIMOS operating system or UNIX System V.

In addition to these products, approximately 240 third-party CAD/CAM software packages are available for Prime hardware products, including software for finite element analysis, kinematics, flat pattern, nesting, piping, and HVAC.

Prime also supplies a variety of systems software, including Information, a relational data base management system; Primenet and Ringnet local area networks; and Prime/SNA, for communicating with IBM environments.

Table 1

Prime Computer Products

Host Computers

Model	Maximum Number of Workstations Supported	Recommended Environment
2350	16	office
2450	24	office
2655	64	office
9655	128	computer room
9750	192	computer room
9955	254	computer room

Host-Dependent Workstations

Model	Resolution	Colors	Screen Size
PW153	1,152 x 860	16	19-inch
PGT4109	640 x 480	16	19-inch
PGT4111	1,280 x 1,024	16	19-inch
PGT4125	1,280 x 1,024	256	19-inch

Principal Application Software

Name	Application
PRIME MEDUSA	CAD program for 2- and 3-dimensional mechanical drafting, design, and modeling
PRIME MEDUSA AEC	Architectural design module using MEDUSA
SAMMIE	Simulates a three-dimensional human model for mechanical test equipment
GNC	2.5- and 3-axis numerical control system
PDGS	Design of curved or free-form surfaces in applications such as the design of automobiles
Facilities Management Plus	Data management for facility planning, leasing, and equipment and construction

Source: Prime Computer, Inc.
Dataquest
July 1986

Prime Computer, Inc.

Prime Computer, Inc.
Prime Park
Natick, Massachusetts 01760
Telephone: (617) 655-8000 Telex: 951571
(Millions of Dollars Except Per Share Data)

CORPORATE PROFILE AS OF DECEMBER 31, 1983

	1979	1980	1981	1982	1983	CAGR 79-83
BALANCE SHEET DATA						
Working Capital	$ 70.1	$ 118.7	$ 145.8	$ 164.9	$ 203.0	30.5%
Long-Term Debt	$ 46.8	$ 60.8	$ 58.1	$ 17.2	$ 16.3	(23.2%)
Shareholders' Equity	$ 44.4	$ 98.9	$ 142.5	$ 228.9	$ 268.2	56.8%
After-Tax Return on Average Equity (%)	48.8%	43.6%	31.2%	24.2%	13.0%	(28.1%)
OPERATING PERFORMANCE						
Revenue	$ 152.9	$ 267.6	$ 364.8	$ 435.8	$ 516.5	35.6%
U.S. Revenue	$ 88.7	$ 170.9	$ 221.1	$ 273.9	$ 321.8	38.0%
Non-U.S. Revenue	$ 64.2	$ 96.7	$ 143.7	$ 161.9	$ 194.7	31.9%
Expenses	$ 122.6	$ 214.7	$ 305.5	$ 367.2	$ 465.5	39.6%
Cost of Revenue	$ 63.9	$ 112.2	$ 159.7	$ 185.7	$ 242.9	39.6%
R&D Expense	$ 12.1	$ 20.4	$ 27.5	$ 37.1	$ 52.1	44.1%
SG&A Expense	$ 46.7	$ 82.1	$ 118.3	$ 144.5	$ 170.5	38.3%
Operating Income	$ 30.3	$ 53.0	$ 59.3	$ 68.6	$ 51.0	13.9%
Interest Expense	$ 3.3	$ 5.7	$ 5.1	$ 1.3	$ 1.7	(15.3%)
Interest Income	$ 0.2	$ 0.0	$ 0.8	$ 0.0	$ 0.0	N/M
Other Income (Expense)	$ 0.0	$ 1.0	$ 0.0	$ 2.0	$ 1.5	N/M
Income before Tax	$ 27.2	$ 46.3	$ 55.0	$ 65.3	$ 47.8	15.1%
NOTE: Pretax Margin	17.8%	17.3%	15.1%	15.0%	9.3%	(15.1%)
Taxes	$ 10.3	$ 15.0	$ 17.3	$ 20.4	$ 15.3	N/M
NOTE: Effective Tax Rate	37.7%	32.4%	31.4%	31.3%	32.0%	(4.0%)
Net Income after Tax	$ 16.9	$ 31.3	$ 37.7	$ 44.9	$ 32.5	17.7%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	$ 39.7	$ 43.9	$ 45.1	$ 45.5	$ 47.9	4.8%
Per Share						
Earnings*	$ 0.43	$ 0.71	$ 0.84	$ 0.99	$ 0.68	12.1%
Dividends*	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	N/M
Book Value*, **	$ 1.71	$ 3.38	$ 4.81	$ 7.30	$ 5.60	34.5%
Price Range*	$13 7/8-24 3/4	$ 8 7/8-41 3/8	$17 1/4-49 1/4	$15 5/8-38 3/4	$13 1/4-30 1/4	N/M
TOTAL EMPLOYEES	2,570	4,011	4,636	5,311	5,927	23.2%

N/M = Not Meaningful
*Restated to reflect three-for-two stock split issued on June 10, 1983
**Calculated using equivalent year-end shares outstanding of 25,991,579 in 1979; 29,242,068 in 1980; 29,635,353 in 1981; 31,372,114 in 1982; and 47,863,089 in 1983

Source: Prime Computer, Inc.
Annual Reports and Forms 10-K
DATAQUEST

Prime Computer, Inc.

Prime Computer, Inc.
Prime Park
Natick, Massachusetts 01760
Telephone: (617) 655-8000 Telex: 951571

LINE ITEMS AS A PERCENT OF REVENUE

	1979	1980	1981	1982	1983
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
U.S. Revenue	58.0%	63.9%	60.6%	62.8%	62.3%
Non-U.S. Revenue	42.0%	36.1%	39.4%	37.2%	37.7%
Expenses	80.2%	80.2%	83.7%	84.3%	90.1%
Cost of Revenue	41.8%	41.9%	43.8%	42.6%	47.0%
R&D Expense	7.9%	7.6%	7.5%	8.5%	10.1%
SG&A Expense	30.5%	30.7%	32.4%	33.2%	33.0%
Operating Income	19.8%	19.8%	16.3%	15.7%	9.9%
Interest Expense	2.2%	2.1%	1.4%	0.3%	0.3%
Other Income (Expense)	0.0%	0.4%	0.0%	0.5%	0.3%
Income before Tax	17.8%	17.3%	15.1%	15.0%	9.3%
Taxes	6.7%	5.6%	4.7%	4.7%	3.0%
Net Income after Tax	11.1%	11.7%	10.3%	10.3%	6.3%
REVENUE PER EMPLOYEE (Thousands of Dollars)	$0.06	$0.07	$0.08	$0.08	$0.09

Source: DATAQUEST

Prime Computer, Inc.

THE COMPANY

Background

Prime Computer, Inc., was incorporated in September 1971 in Delaware. The Company designs, manufactures, markets, and services general-purpose minicomputer products. Prime's products are used mainly in scientific and business data processing applications and, to an increasing extent, in office automation/word processing and computer-aided design/computer-aided manufacturing (CAD/CAM) applications.

Highlights

In February 1984, the Company announced an agreement under which Prime would purchase from Computervision Corporation joint ownership of Revision Four of the MEDUSA mechanical drafting, design, and three-dimensional solids modeling software package. Under the terms of the agreement, which began on June 1, 1984, both companies will market MEDUSA on a worldwide basis.

In January 1984, the Company announced an agreement with CADTRAK Corporation, of Sunnyvale, California, whereby Prime will sell, service, and support CADTRAK's Design Station One.

Prime signed an agreement with CADCentre Limited, of Cambridge, England, in March 1984 under which Prime acquired nonexclusive worldwide marketing rights to Graphical Numerical Control (GNC), a software package for machine tool programming.

In July 1983, the Company introduced the Prime 9950, an extension of the 50 Series product line, which provides 50 percent greater performance than the Prime 850, previously the Company's highest-performance system.

For the office environment, Prime introduced the Prime Producer 100, the first in a line of microprocessor-based workstations designed for integrated office environments.

For the CAD/CAM market, Prime made several new software and workstation product announcements in 1983. It introduced the PW150 workstation with direct communications to the Prime 50 Series host computers, and established a joint venture with Ford Motor Company to market the Product Design Graphics System (PDGS). In addition, Prime entered a marketing agreement with Logan Associates, of the United Kingdom, giving Prime exclusive marketing rights to LOCAM, a computer-aided process planning system, on a worldwide basis.

Prime Computer, Inc.

In the past, Prime's CAD/CAM marketing strategy was clearly oriented toward end users. Sales efforts were directed at the auto industry, aerospace companies, and other large end users. Prime provided hardware--not total system solutions. A decided change in this strategy occurred in 1983, when Prime began making a concerted effort to provide total turnkey system solutions to current and prospective customers in its primary markets.

To implement the new market strategy, Prime has made substantial investments in research and development and in expanding its sales and customer service organizations. Based on the technical strengths of the Company's computer products and the new levels of expenditure to augment total systems offerings, DATAQUEST believes that Prime can establish a foothold in the CAD/CAM marketplace.

Operations

Prime Computer operates under a functional organization setup. Executive offices are located in Prime Park, a 35-acre, three-building facility in Natick, Massachusetts. At the end of 1983, the Company had manufacturing facilities in Framingham, Massachusetts; Coolock, Ireland; and Ponce, Puerto Rico. The Company employs approximately 1,025 people in its manufacturing operations. Prime's engineering group is also located in Framingham, Massachusetts.

Prime and its subsidiaries employed a total of 5,927 persons as of December 31, 1983.

Research and Development

During 1983, Prime spent $52.1 million for research, development, and engineering of computer systems, workstations, peripherals, and software. As of December 31, 1983, approximately 939 employees were engaged in research, development, and engineering activities.

The Company's research and engineering emphasis is on enhancements to existing products, development of new products, and expansion of product applications.

Marketing and Distribution

Prime's marketing and distribution structure reflects the Company's emphasis on sales to end users. Prime's products are sold primarily through a direct sales force located in the United States, Western Europe, Canada, and Australia. As of December 31, 1983, Prime's worldwide sales organization employed approximately 1,849 persons, including sales representatives, systems engineers, and other support personnel. This organization consists of approximately 930 persons in 64 locations in the United States and 919 persons in 54 locations outside of the United States. Prime also offers its products through independent international reselling distributors in Latin America, Europe, Africa, the Middle East, New Zealand, and Asia.

During 1983, the Company created the Authorized Distributor Program to consolidate the various groups of independent domestic distributors such as Prime's Authorized Information Dealers, Systems Builders, and Authorized Remarketers under a single program. The program currently has 25 authorized distributors and 131 subdistributors.

Prime also maintains various marketing programs to encourage independent software marketers and developers to aid it in providing its customers with a variety of software programs for use with its computer systems.

Customer Service

Prime had 113 customer service locations in the United States and 61 customer service locations outside the United States as of December 31, 1983. The customer service organization employs approximately 1,505 persons worldwide. Products sold by Prime's international distributors are serviced either by the distributors or by third parties retained by the distributors.

CAD/CAM Business

DATAQUEST estimates that Prime's 1983 revenue from its CAD/CAM operations was $77.9 million. Over the past year and a half, Prime has made a commitment to its CAD/CAM business, as evidenced by the formation of the CAD/CAM Business Group, the acquisition of Compeda, and the marketing agreements with the CADCentre, Computervision, Ford, and Logan.

Products

Prime's CAD/CAM products operate on six versions of its 50 Series, 32-bit minicomputers. These computers use the PRIMOS operating system and PRIMENET networking software package. The 50 Series product line includes the 2250, the 250-II, the 550-II, the 750, the 850, and the 9950.

Prime Computer, Inc.

The Prime Workstation 200 series (PW200) is a family of standalone graphics workstations. Each model contains a 32-bit graphics processor, display controller, disk drive, and magnetic tape unit. The PW200 is available in four models and is compatible with the Prime 50 series systems.

Prime also markets the CADTRAK Design Station One (DS-1), manufactured by CADTRAK, of Sunnyvale, California. The DS-1 was designed specifically to support PDMS software on Prime 50 Series computers.

In addition, Prime markets a display terminal that is available in either monochrome or color. The Company also has an OEM agreement with Lundy Electronics to sell Lundy's Ultragraf display in support of the PDGS software licensed from Ford Motor Company.

Software available directly from Prime includes:

- MEDUSA--A 3-D mechanical drafting, design, and solids modeling system
- PDGS--(Product Design Graphics System)--A curved surface design system developed by Ford Motor Company
- EDMS--(Electronic Design Management System)--A data management system for electronic design
- PDMS--(Plant Design and Management System)--A design system for large plant facilities developed by the CADCentre, of Cambridge, England
- THEMIS--A hierarchical logic simulation system
- DRAGON--A 2-D drafting system
- LOCAM--A manufacturing process planning system
- MIDASPLUS--A multiple index data base access system
- MCS--A manufacturing control system
- GNC--(Graphics Numerical Control)--A machine tool programming system

Other CAD/CAM software packages that are either marketed by Prime or are available for use on Prime computers from third-party vendors include:

- SCI-CARDS--A PC board design and layout system from Scientific Calculations, Inc.
- ANSYS--A finite element analysis system from Swanson Associates
- PATRAN--A finite element modeling system from PDA Engineering
- TRI-FLEX--A pipe stress analysis system from AAA Technology
- GARDS--A gate array layout system from Silvar-Lisco
- CAL-MP--A standard cell layout system, also from Silvar-Lisco

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Racal-Redac Limited

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Racal-Redac Limited is a wholly owned subsidiary; therefore, balance sheet data are unavailable.

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Racal-Redac Limited

THE COMPANY

Background

Racal-Redac Limited (Redac) designs, manufactures, markets, and distributes turnkey computer-aided design (CAD) systems for electronic design applications. The Company, a wholly owned subsidiary of the Racal Electronics Group Plc, was founded in Tewkesbury, England, in 1965. In 1975 Racal-Redac, Incorporated (originally Redac Interactive Graphics), in Westford, Massachusetts, was formed as the Company's North American distributor and was purchased by Racal Electronics in 1985. These two companies are now linked by a joint management structure in which the President of Racal-Redac, Incorporated, reports to the Managing Director of Racal-Redac Limited. The locations and interrelationships of these companies are listed in Table 1.

Redac systems range from low-cost, personal computer-based design stations to standalone and host-dependent design stations. Redac currently has over 1,678 workstations installed worldwide.

Table 1

Racal-Redac Limited
ORGANIZATIONAL STRUCTURE

Company	Location	Type
Racal Electronics Group, Plc	United Kingdom	Parent
Racal-Redac, Limited	United Kingdom	Principal Subsidiary
Racal-Redac, Incorporated	United States	Subsidiary

Source: DATAQUEST

Highlights

The following is a list of recent Company highlights in reverse chronological order:

- April 1985--The Company announced shipment of REDBOARD, a low-cost, personal computer-based program for computer-aided printed circuit board (PCB) design, and REDLOG, PC-based EDA software for logic analysis and capture. These two applications packages are marketed together as part of the REDCAD personal computer products line and both run on the IBM PC AT or PC XT, or on any Redac-approved compatible.

Racal-Redac Limited

- January 1985--Racal Electronics acquired 100 percent ownership of Redac Interactive Graphics.

- July 1984--Gene Robinson, former Telesis Vice President of Sales and Marketing, was named President of Racal-Redac, Incorporated, with responsibility for all U.S. sales, marketing, finance, and manufacturing, as well as product development and support functions.

- June 1984--Redac introduced Computer Integrated Electronic Engineering (CIEE) software. CIEE is a modular software system which provides specific software modules for different stages of the design cycle and integrates these modules with a relational data base.

- June 1984--In conjunction with the CIEE announcement, Redac signed a joint marketing agreement with Apollo Computer involving CIEE software and Apollo 32-bit workstations.

- June 1984--Redac acquired worldwide marketing and manufacturing rights to Inmos Plc's IC CAD system.

Organization

Racal-Redac Limited employs 450 persons in 15 locations worldwide. Approximately 150 employees are associated with U.S.-based Racal-Redac, Incorporated. Redac's corporate headquarters, as well as the Company's major research and development activities and manufacturing facilities, are centered in the United Kingdom at Tewkesbury, England. The Company maintains manufacturing facilities in the United States at Racal-Redac, Incorporated, Westford, Massachusetts. This location also serves as the center for North American sales, product marketing, and distribution. These two locations comprise the Company's primary facilities.

Marketing and Sales

Racal-Redac markets its standalone and host-dependent systems on a worldwide basis through a direct sales force, manufacturing representatives, and distributors. European and Far Eastern marketing are handled by Racal-Redac Limited, while North American sales and marketing operations are handled by Racal-Redac, Incorporated. The Company's primary systems marketing focus is concentrated on electronics companies with annual revenues in excess of $50 million.

Racal-Redac Limited

Table 2 represents DATAQUEST's estimates of Racal-Redac's 1984 revenue distribution by region.

Table 2

Racal-Redac Limited
1984 REVENUE DISTRIBUTION BY REGION

Region	% of Total Revenue
North America	39%
Europe	54%
Rest of World	7%

Source: DATAQUEST

Redac's U.S. sales force consists of 28 individuals engaged in direct sales and 18 individuals in sales support roles. The Company maintains eight regional and district sales headquarters in the United States at the following locations:

- Irvine, California
- Milpitas, California
- Toronto, Canada
- Orlando, Florida
- Chicago, Illinois
- Westford, Massachusetts
- King of Prussia, Pennsylvania
- Richardson, Texas

The Company maintains six North American sales offices, in addition to regional offices, located in the following cities:

- San Diego, California
- Denver, Colorado
- Ellicott City, Maryland
- Bloomington, Minnesota
- Kings Park, New York
- Bellevue, Washington

Overseas marketing operations are headquartered in Tewkesbury, England, with principal sales offices in the following locations:

- Gloucestershire, England
- Bagnolet-Cedex, France
- Tokyo, Japan
- Woerden, The Netherlands
- Stockholm, Sweden
- Munich, West Germany

Racal-Redac Limited

Research and Development

Racal-Redac was organized in 1965 primarily as a research company specializing in computer-based systems for the electronics industry. Over the years, Redac's emphasis has centered on the development of modular, workstation products. As a member of the Racal Electronics Group, Racal-Redac enjoys significant financial and technical resources from more than 100 affiliated companies in virtually every aspect of the electronics industry. Company sources estimate Redac's R&D expense at 10 percent of revenues.

In recent years, Redac has expanded its traditional concentration from PCB applications to include front-end logic design and analysis and VLSI design capabilities.

Manufacturing

Redac designs, manufactures, sells, and supports a range of modular CAD/CAM design stations and applications. In addition, the Company uses OEM arrangements and strategic third-party software agreements for key system components. Major 1984 OEM supplier and third-party software arrangements include:

- A joint marketing agreement with Apollo Computer involving Redac CIEE software and Apollo 32-bit DOMAIN computers.
- An exclusive marketing and manufacturing agreement for Inmos Plc's system for VLSI design.
- An agreement with IBM to become a Value-Added-Remarketer (VAR) for the IBM PC XT and PC AT.
- A third-party marketing agreement with the New Jersey-based HHB Softron involving HHB's CADAT software for PCB simulation.
- A third-party marketing agreement with Relational Database Systems, Inc., concerning INFORMIX relational data base software.

Racal-Redac Limited

MAJOR HISTORICAL MILESTONES

Since its creation in 1965, Racal-Redac has continued to develop and refine products specifically for electronic engineering and design applications. The Company's major historical highlights, in reverse chronological order, include:

- June 1984--The Company introduced Computer Integrated Electronic Engineering (CIEE), a modular software system which supports PCB, hybrid, gate array, standard cell, and full custom design and simulation.

- June 1980--Product introduction of the Racal-Redac system-based CADET workstation.

- 1975--Product introduction of the Redac Mini, based on the Digital Equipment Corporation PDP-11.

- Early 1970--The Company installed the first turnkey CAD/CAM system based upon Digital Equipment's PDP-15/20.

CAD/CAM PRODUCTS

Redac supplies the electronics industry with systems for printed circuit board (PCB) design. The Company markets most of its applications software packages with the requisite hardware.

Recently, the Company has discontinued marketing CADET systems and has shifted its low-end emphasis to REDCAD, its personal computer based system. REDCAD includes REDBOARD (PCB design software) and REDLOG (EDA logic software and capture). Besides the systems the Company already offers, in 1985 Redac began marketing Apollo's 32-bit Domain computers with VISULA application software. VISULA is the Company's SMD and fine line technology product. In 1985, the Company also announced the ISIS (Integrated Systems in Silicon) workstation for IC design, based on INMOS Plc's system.

Most of Racal-Redac's design products can be linked and supported by a central VAX running DSM-6 software. REDLOG, REDBOARD, and the MAXI II can exchange graphics. Net lists are automatically generated and can be moved from system to system. All systems can also share central data bases and peripherals, managed by DSM-6 software or Apollo Domain software.

Racal-Redac Limited

Tables 3 and 4 list the systems and applications software currently available from Redac.

Table 3

Racal-Redac Limited
SYSTEM PRODUCTS

Product	Hardware	Product Type	Resolution
VISULA	DN660	Standalone	1,024 x 1,024
DSM-6	VAX 11/780	Host-dependent	N/A
DSM-6	VAX 11/750	Host-dependent	N/A
MAXI II	PDP 11/73	Standalone	512 x 512
REDCAD	PC	PC	N/A
REDDESIGN	PC	PC	N/A
ISIS	VAX/ASP* DN300/ASP*	Host-dependent Standalone	N/A 1,024 x 800

N/A = Not Available
*Proprietary Application-Specific Processor

Source: DATAQUEST

Table 4

Racal-Redac Limited
TURNKEY AND SOFTWARE PRODUCTS

Name	Description
DSM6	VAX-based Design System Manager software for PCB design, schematic drawing, and logic simulation package
MAXI II	PDP 11/73-based total PCB design and schematic capture application system including autoplace and autoroute with full post-processor support and design rules check
REDBOARD	IBM PC-based physical PCB layout software including automatic place and route and DRC
REDDESIGN	IBM PC-based EDA design software including waveform analysis and the CADAT fault simulator
REDLOG	IBM PC-based EDA application software for logic analysis and schematic capture
VISULA	Apollo-based front-to-back EDA/PCB design and schematic layout application software package including 2-D, design rules check, simulation and automatic gridless routing; also supports surface-mounted device and fine line technology

Source: DATAQUEST

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Racal-Redac Limited

Racal-Redac Limited
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(Racal-Redac Limited is a wholly owned subsidiary; therefore, balance sheet data are unavailable.)

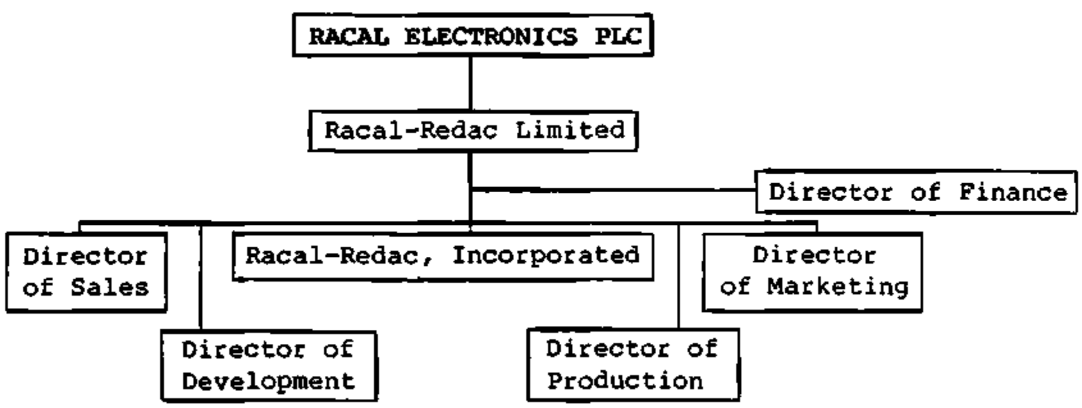
Racal-Redac Limited

BACKGROUND

The Company

Racal-Redac Limited, a wholly owned subsidiary of Racal Electronics Plc, was founded in 1965 to develop and apply the science of computer-aided design to the needs of the electronic industry. In 1975 Redac Interactive Graphics, Incorporated, Westford, Massachusetts, was formed to distribute CAD/CAM systems manufactured by Racal-Redac Limited in North America. Racal Electronics Plc acquired a 51 percent interest in Redac Interactive Graphics, Incorporated, in October 1981, and the company name changed to Racal-Redac, Incorporated. Presently, Racal Electronics Plc holds a 64 percent interest in Racal-Redac, Incorporated, and will absorb the remaining share of the company over the next two years. The president of Racal-Redac, Incorporated, reports to the Managing Director, Racal-Redac Limited. The organization structure is shown in Figure 1.

Figure 1



Source: Racal-Redac, Incorporated

Racal-Redac Limited

Racal-Redac Limited (Redac) designs, manufactures, markets, and services turnkey computer-aided-design (CAD) systems used for designing printed circuit boards (PCBs). The systems range from low-cost, standalone design stations based on microprocessors, to multiterminal systems based on 32-bit minicomputers. Presently, Redac has over 1,100 systems installed worldwide.

Operations

Redac designs, manufactures, sells, and supports a range of modular CAD/CAM design stations and application packages. Manufacturing facilities are located in the United States and the United Kingdom. The systems range from low-cost single-stations to multistation systems with integrated management control functionality.

Redac's applications software shares a common data base affording compatibility among engineering design, logic design, simulation performance, design layout, and the finished product.

Redac's sales revenue for 1982/1983 was nearly $35 million. No single customer accounts for more than 10 percent of the Company's revenue. Over 1,100 Redac systems are installed worldwide. The United Kingdom, the United States, and West Germany are the major markets for Redac's products.

Marketing

Redac's systems are marketed on a worldwide basis through a direct sales force. European and Far East marketing are handled by Racal-Redac, Limited, while Racal-Redac, Incorporated, is responsible for North American marketing operations. The Company's primary market is electronic companies with annual revenues exceeding $50 million. Redac has three regional sales offices in the United States and also maintains offices in Finland, France, Sweden, The Netherlands, the United Kingdom, and West Germany. Redac has distributor arrangements in Japan, Spain, and Switzerland.

Redac systems are fully hardware and software supported. The Company employs 30 applications engineers. Redac maintains training centers at each of its regional offices in addition to the facilities at corporate headquarters in the United States and in the United Kingdom.

Racal-Redac Limited

Organization

Redac employs 450 persons worldwide. Of this number, 55 are engaged in direct sales and 30 are applications engineers. The other personnel are predominantly manufacturing, administrative, and customer support people.

The Company's executive offices are located in leased facilities in Tewkesbury, England, and Westford, Massachusetts. These facilities comprise 95,000 square feet.

CAD/CAM BUSINESS

Racal-Redac supplies computer-aided engineering systems for printed circuit board design to the electronics industry.

Design Stations

- Redac Cadet--Low-cost microprocessor-based systems. Three versions of the station are available: a portable, desktop configuration; a desk-mounted station with the microcomputer incorporated in the desk unit; and an enhanced desk-mounted station equipped with a Winchester disk drive. Monochrome or color high-resolution raster scan graphics displays are available.

- Redac Mini--Based on a Digital Equipment minicomputer. The system includes a dual-drive, removable disk subsystem, and features a high-resolution 19-inch raster scan graphics display with a choice of 15 colors.

- Redac Maxi--Based on a Digital Equipment minicomputer. The system includes a dual-drive, removable disk subsystem and a high-performance raster scan graphics display with a color palette comprising 4,096 colors.

Multistation Systems

- DSM (Design Station Manager) 2-Series--Based around Digital Equipment Corporation's PDP11 processors. A range of Redac design stations can be connected on- or off-line to a DSM 2-Series computer.

- DSM 6-Series--Based on Digital Equipment Corporation's VAX computers; utilizes a standard VAX/VMS operating system. A range of design stations can be connected on- or off-line to the DSM 6-Series computer.

Applications

Redac offers the following primary application packages.

PCB Design

The Printed Circuit Board (PCB) Design software package provides graphics tools for designing printed circuit boards. Routines are provided for interactive placement and routing of components and circuit connections.

The Design Aids package is an optional program that includes user-defined Automatic Component Placement and Automatic Track Routers. On the more powerful Redac systems, the Design Aids package also includes Automatic Gate and Pin Swapping.

Schematic Drawing

Redac Schematic Drawing packages include symbol placement, interconnections, text placement, gate allocation, and a facility to designate repetitive areas of circuitry as sub-drawings.

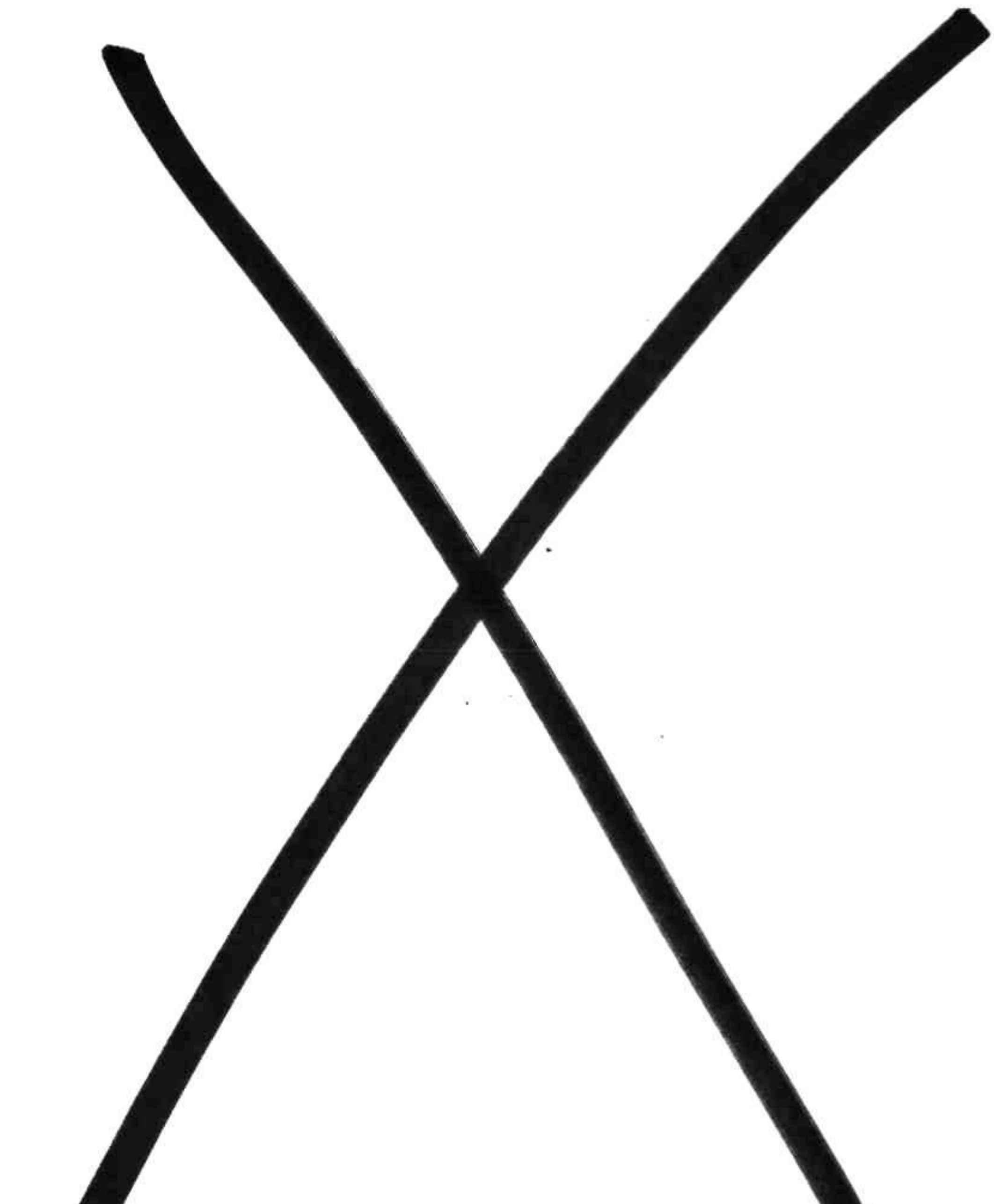
On the more powerful Redac systems, a "group" facility enables a number of items--such as symbols and connections--to be defined as a collective entity. Once defined, the group can be interactively moved.

Logic Simulation

The Redac SYMCAD simulator package simulates a digital circuit's behavior and checks both functionality and timing. The simulator provides a "worst case analysis" that allows the designer to modify the schematic to achieve correct operation of the circuit.

Equipment Enclosure Design Package

This electronic equipment packaging system features a top-down design approach with facilities for specifying dimensions and tolerances and for calculating the weight and center of gravity of an assembly or part. It can produce data to drive numerically controlled presses and punches.



Scientific Calculations, Inc.

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Scientific Calculations, Inc., is a privately held company; therefore, balance sheet data are unavailable.

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Scientific Calculations, Inc.

THE COMPANY

Background

Scientific Calculations, Inc. (SC), a privately held company founded in 1963, has been a vendor of turnkey CAD/CAM systems since 1970. SC is headquartered in Fishers, New York, with foreign subsidiaries in the United Kingdom, France, Italy, and West Germany. The Company began shipment of its SCICARDS system for printed circuit design in 1975; shipment of its Microelectronics Design System (MEDS) product for integrated circuit design began in 1983.

Highlights

- February 1985--The Company announced SCIDESIGN, a new EDA applications software product based on the IBM PC, at the ADEE Conference in Anaheim, California.

- November 1984--SC consolidated its Los Angeles operations into a combined sales and service bureau in Torrance, California, in order to accommodate expanded operations and staff.

- November 1984--Rochester Institute of Technology's School of Applied and Industrial Studies (SAIS) announced integration of SCICARDS system training into its CAD curriculum.

- September 1984--SC opened a sales office in Toronto, Canada.

- September 1984--SC withdrew support for its product line on the IBM Series 4300.

- August 1984--Digital Equipment Corporation purchased a minority interest in the Company. SC and Digital have been cooperative marketing partners since 1979, and SCICARDS and MEDS software run on Digital's VAX line of superminicomputers.

- February 1984--First shipments of the MC68000-based SC Design Station began.

- December 1983--Asahi Optical Company, Ltd., of Japan (the Company's Japanese distributor) entered into an agreement with SC to remarket the SCICARDS program and SC Design Station in Japan.

Scientific Calculations, Inc.

DATAQUEST estimates that Scientific Calculations' 1984 sales were $41.3 million, which represents a 40 percent increase over 1983 sales. The Company has an installed base of over 375 systems worldwide and is the second largest PCB CAD vendor, with approximately 12.3 percent share of the 1984 market. At present, SC's products support interfaces to other major CAD/CAM vendors' systems, and the Company provides full integration between its own products. SC plans to have all its products supported on the SC Design Station in the future.

Organization

Scientific Calculations' corporate headquarters, engineering center, and design service facilities are located in Fishers, New York. The Company employs approximately 400 individuals worldwide.

The Company maintains international headquarters in London, England, with other foreign offices located in Canada, France, Italy, and West Germany. In January 1984, SC opened an additional facility in London that houses customer support, training, program maintenance, and demonstration and benchmarking facilities. The Company has 52 employees in Europe. DATAQUEST estimates that approximately 15 percent, or $6.7 million of the Company's 1984 revenue, was from Western European sales.

Table 1 is a listing of Scientific Calculations' main worldwide facilities by location, use, and size.

Table 1

Scientific Calculations, Inc.
FACILITIES

Location	Use	Approximate Size (Square Feet)
Fishers, New York	Administration and corporate headquarters, marketing, and R&D	34,000
Rochester, New York (Accell Corporation)	Manufacturing and R&D of SC Design Stations	34,000
San Jose, California	Design center, sales office	17,000
Santa Cruz, California	R&D (MEDS)	7,000
Paris, France	Design center, sales office	9,000
London, England	International headquarters, design center, sales office	8,000
Boston, Massachusetts	Design center, sales office	6,000
Torrance, California	Design center, sales office	6,000
Dallas, Texas	Design center, sales office	6,000
Chicago, Illinois	Design center, sales office	6,000

Source: Scientific Calculations, Inc.

Scientific Calculations, Inc.

Research and Development

Most of the Company's research and development (R&D) efforts are centered in Fishers, New York, particularly for R&D of the SCICARDS program. This group's efforts are directed toward software enhancements for the existing systems, as well as the development of new systems capabilities.

Development and manufacture of the SC Design Station, the Company's standalone workstation, is done by Accell Corporation of Rochester, New York, a majority-owned SC subsidiary.

The MEDS technical center is located in Santa Cruz, California, and is currently dedicated to development of the Microelectronic Design System (MEDS) for VSLI design automation.

SC's 1984 R&D expenses are estimated by Company sources at approximately 15 percent of revenue.

Marketing and Sales

The Company's marketing group performs several sales-oriented functions, including customer support. The marketing group has the additional responsibility for all marketing communications, sales literature, and user documentation, as well as advertising and public relations. Marketing is also tasked with product specification. The group evaluates the needs and requests of SC system users and prospective customers, and it schedules software enhancements as required.

The Company's sales activities are organized into five domestic regions and a European operation. SC's direct sales and sales support force consists of approximately 45 individuals. The Company currently maintains eighteen regional sales offices, including, most recently, a new sales office in Toronto, Canada, and a combined sales and design service center in Torrance, California.

The locations of U.S. sales offices are as follows:

- Bellevue, Washington
- Boca Raton, Florida
- Boston, Massachusetts
- Chicago, Illinois
- Dallas, Texas

- Dearborn, Michigan
- Edina, Minnesota
- Englewood, Colorado
- Exton, Pennsylvania
- Rockville, Maryland
- San Jose, California
- Torrance, California
- White Plains, New York

Non-U.S. sales are handled by wholly owned subsidiaries located in the following places:

- Cologne, West Germany (SC GmbH)
- London, England (SC (U.K.) Ltd)
- Milan, Italy (SC Italia SRL)
- Paris, France (SC S.A.R.L.)
- Toronto, Canada

Support

The Company's Customer Services Group is divided into Customer Support and Customer Training. Customer Support includes post-sales application support, system support, and a problem reporting and tracking system. Customer Training provides standardized training programs and materials. SC's eighteen worldwide sales facilities provide the installed base with customer support and training, as well as service bureau capabilities in specified locations.

The Company's Design Services Group, founded in 1978, provides design services to SCICARDS users experiencing temporary work overflows, and to nonusers on a per-job basis. Increasing demand for services led to expansion of this group beyond its Fishers, New York, headquarters. The Company currently maintains seven Design Service Centers (service bureaus) in the following worldwide locations:

- Sunnyvale, California
- Torrance, California
- London, England
- Paris, France
- Chicago, Illinois
- Boston, Massachusetts
- Dallas, Texas

Major Historical Milestones

Listed in reverse chronological order are several milestones depicting SC's growth since its 1970 entrance into the CAD/CAM market.

- November 1983--The Company introduced the SC Design Station, including SCICARDS and SCHEMACTIVE software packages, for under $100,000. (The SC Design Station is the only hardware product manufactured by the Company.)
- May, 1982--SC and Daisy Systems Corporation announced a marketing agreement to support the Daisy Logician engineering workstation on SC's MEDS and SCICARDS systems. The Logician is able to capture electrical data for MEDS and SCICARDS.
- January, 1982--SC opened its London headquarters to provide sales support, training, and maintenance, as well as demonstration and benchmark facilities, for clients in Western Europe and the Middle East.
- 1975--First shipments of the SCICARDS system for PCB design began.

Scientific Calculations, Inc.

CAD/CAM PRODUCTS

Scientific Calculations designs its software to run on VAX and Prime computers, as well as on its own 68000-based standalone design system, the SC Design Station, manufactured in-house by Accell Corporation, Rochester, New York. Shipments of the new 68020-based SC Design Station are expected to begin in May, 1985. In February, 1985, the Company announced the development of a new EDA logic design and analysis software program, called SCIDESIGN, which runs on an IBM PC. Table 2 lists SC's currently available system, workstation, and applications software products.

Table 2

Scientific Calculations, Inc.
PRODUCTS

SYSTEMS

Name	Manufacturer	Word Size	Maximum Number of Workstations	Distribution
VAX 11/750	Digital	32-bit	2	OEM/MFG.
VAX 11/780	Digital	32-bit	6	OEM/MFG.
VAX 11/785	Digital	32-bit	8	OEM/MFG.
VAX 8600	Digital	32-bit	15	OEM/MFG.
550	Prime	32-bit	2	MFG.
750	Prime	32-bit	4	MFG.
950	Prime	32-bit	4	MFG.
PC AT	IBM	16-bit	1	MFG./other
PC XT	IBM	16-bit	1	MFG./other

WORKSTATIONS

Name	Type	Resolution	Number of Colors
Megatek	Host-dependent	512 x 512	8
SC Design Station (Accell)	Standalone	512 x 648	16

APPLICATIONS SOFTWARE

Name	Description
SCICARDS	Automated design of printed circuit boards
SCHEMACTIVE	Automated design of schematic drawings
MEDS	Automated design of VLSI circuits, including gate array, standard cell, and full custom design
SCIDESIGN	Interactive EDA logic design and analysis, including schematic generation, capture, and verification, based on the IBM PC AT and PC XT

Source: Scientific Calculations, Inc.

Scientific Calculations, Inc.

Scientific Calculations, Inc.
7635 Main Street
Fishers, New York 14453
Telephone: (716) 924-9303 Telex: 97-8316

(Scientific Calculations is a privately held company; therefore, balance sheet data are unavailable.)

Scientific Calculations, Inc.

THE COMPANY

Background

Scientific Calculations, Inc. (SC), a 21-year-old privately held vendor of turnkey CAD/CAM systems, is headquartered in Fishers, New York. The Company began shipment of its SCICARDS system for printed circuit board design in 1975. SC's system for integrated circuit design, the Microelectronics Design System (MEDS), began shipment in 1983.

Highlights

Company sources reported SC's 1983 sales were $34.2 million, a 41 percent increase over 1982 sales. Table 1 shows DATAQUEST estimates of the Company's revenue distribution. In November 1983, SC introduced the Electronic Design Station (EDS) including SCICARDS and SCHEMACTIVE programs for less than $100,000. EDS is the only hardware product manufactured by SC.

Also in November 1983, SC announced that it would offer SCICARDS software as a full turnkey system operating on the IBM 4300 series computers using IBM's new 5080 graphics workstation. SC thus became the first value-added remarketer (VAR) for the 5080. In addition, SC reported that its MECANIX system for mechanical design is in Beta test and that shipments are expected to begin in the second quarter of 1984.

Table 1

SCIENTIFIC CALCULATIONS, INC.
1983 ESTIMATED REVENUE DISTRIBUTION
(Millions of Dollars)

Source	Revenue	Percentage
SCICARDS	$27.4	80%
MEDS	3.8	11
Service Bureau	3.0	9
Total	$34.2	100%

Source: DATAQUEST

Widespread industry acceptance of SC's PCB design software is evidenced by the Company's continued growth over the years. DATAQUEST estimates that SC is the third largest PCB CAD vendor, with approximately 7 percent market share. At present, SC's products support interfaces to major CAD/CAM vendors' systems and provide full integration between its own products. SC plans to have all its products supported on the EDS in the future.

SC's decision to manufacture its own hardware is a departure from its past software/OEM product strategy and will present SC with new channels and challenges for product distribution. DATAQUEST believes that SC's strategy to integrate comprehensive electronic CAD software with mechanical CAD applications, coupled with SC's enhancements to its existing products, will assure the Company a viable position in the CAD/CAM market in the future.

Operations

DATAQUEST estimates that as of December 1983, SC had an installed base of approximately 225 systems and 600 workstations. The Company expects continued growth of approximately 65 percent per year for the near future.

SC's corporate headquarters, engineering center, and design service facilities are located in Fishers, New York. The Company also maintains Design Service Centers (service bureaus) in Sunnyvale, California; Chicago, Illinois; Boston, Massachusetts; Dallas, Texas; London, England; and Paris, France.

SC has 10 sales offices located across the United States, including a recently opened facility in Waltham, Massachusetts.

SC employs approximately 375 people worldwide.

International Operations

SC maintains international headquarters in London, England, to service Western Europe and the Middle East. In January 1984, the Company opened an additional facility in London, which houses customer support, training, program maintenance, and demonstration and benchmarking facilities. The Company has 32 employees in Europe. DATAQUEST estimates that approximately 35 percent, or $12 million of its 1983 revenue, were from non-U.S. Sales.

Marketing

SC maintains a total of 13 sales offices worldwide, with 50 individuals devoted to sales. Sales activities are organized into five domestic regions and include European operations.

A pre-sales administration group functions within the sales organization to provide support to that organization. Primary responsibilities include providing current literature, pricing information, and technical presentations to customers.

The marketing group performs several sales-oriented functions, including customer support. This includes initial system training and follow-up support. In addition, this group is responsible for all marketing communications. The marketing group develops sales literature, prepares user documentation, and coordinates advertising and public relations activities. Another marketing function is product specification. The group evaluates the needs and requests of systems users and prospective customers, and schedules software enhancements as required.

Research and Development

SC maintains three research and development facilities. The Fishers, New York, facility houses R&D for the SCICARDS program. This group's efforts are directed toward developing software enhancements for existing systems, as well as developing new systems capabilities.

The MEDS technical center is located in Santa Cruz, California, and is currently being expanded. This facility is dedicated to development of the Microelectronic Design System (MEDS) for VLSI design automation. The MECANIX technical center is located in San Jose, California.

CAD/CAM ACTIVITIES

Products

SCICARDS System

Shipments of the SCICARDS system, SC's principal product, began in 1975. SCICARDS is a proprietary automatic/interactive, computer-aided system for printed circuit board designs up to 20 layers, with output that can be directly used by automated manufacturing equipment.

SCICARDS runs on Digital Equipment's VAX 11/750 and 11/780; various IBM equipment running on the VM 370/CMS operating system and the IBM 4300 series; and Prime Computer's entire 50 Series line of computers. Depending on CPU size, a SCICARDS system can support from 2 to 6 terminals, requiring from 2 to 8 Mbytes of memory. The system also supports hardware links to DECnet, IBM 3270, and PRIMENET.

SCICARDS supports Megatek's 7250 high-resolution color raster displays, using eight colors from a palette of 4,096 hues. Additional 7250 graphics features include dynamic pan and zoom, with scales of 2x, 4x, and 8x--both accomplished without loss of resolution.

The Megatek graphics workstation is offered with a high-performance channel speed connection, allowing the workstation to be located up to 1,000 feet away from the host computer. Fiber-optic links are supported for distances greater than 1,000 feet from the host computer. The long-line connection is available for new workstations or as a field-installable upgrade to existing systems, and provides full-picture update in less than one-third of a second.

SCICARDS supports output to a variety of plotters and printer/plotters, including Benson, Calcomp, Gerber, Hewlett-Packard, Varian, Versatec, Xynetics, and Zeta. Interfaces are available to Applicon, Auto-trol, Calma, Computervision, and Racal-Redac systems, to the Tegas Logic Simulator, and to test equipment manufactured by Fairchild, GenRad, Hewlett-Packard, and Teradyne.

The Auto-plus concept of the SCICARDS system allows the designer automatic or interactive control of placement and routing functions. Automatic sequences and routines can be interrupted at will for designer input, with the system immediately incorporating any modifications into subsequent automated operations. The designer maintains control, enabling him/her to incorporate varying design philosophies and strategies, while maximizing system use. SCICARDS performs continuous, dynamic, design rules checking, yet allows designer override when necessary.

The data base structure of SCICARDS also enables the user to adapt the system to perform automated test functions on manufactured printed circuit boards.

SCICARDS systems are priced from approximately $75,000 for the Design Station to $475,000 for a four-station VAX configuration. SCICARDS software is available for use on the purchaser's in-house equipment for a license fee of $135,000 with monthly service charges of $3,300. The service charge includes annual software updates, which enables systems to evolve with technological advancements and eliminates the need to purchase product upgrade options. Recently, the SCICARDS program was enhanced to permit design of thick-film hybrid circuits.

SC has announced and shipped MERIT, the next generation of its SCICARDS program. MERIT allows larger, more complex, and diverse boards to be placed and routed.

SCHEMACTIVE Program

The SCHEMACTIVE Program is an interactive software program that allows the designer to input schematic logic diagrams for the circuitry contained on a printed circuit board. SCHEMACTIVE provides instant visual feedback as well as new documentation and error-checking capabilities.

SCICARDS and SCHEMACTIVE are linked to a common data base that allows the physical design of a PCB and the associated schematic documentation to be updated simultaneously as changes are made to a circuit during design. SCHEMACTIVE permits automatic back-annotation of the schematic logic diagram at any time during the physical layout of the PCB. Engineering change orders and in-process design changes are also automatically accommodated.

Microelectronic Design System (MEDS)

MEDS is a turnkey system for the automation of the physical layout of integrated circuits. The system automates layout and performs tasks from logic definition through pattern generation, excluding simulation. MEDS began commerical shipments in 1983; as of December 1983, 11 MED systems were installed.

MEDS is supported on Digital Equipment's VAX 11/780 and VAX 11/750. The system supports up to four Megatek graphics workstations, offering high-resolution graphics display. MEDS also supports the Digital VT100.

Planned enhancements for MEDS include a design-rule checking language offering step coverage, reflection checking, crevasse checking, and conditional specifications. Interfaces are available for Calma GDS I and GDS II systems. SC has approximately 15 programmers dedicated to MEDS development.

MEDS is available as a turnkey system for an average price of $475,000. A software license is available for $150,000, plus a monthly service charge of $3,500. The monthly service charge covers customer support as well as all future revisions and enhancements.

Electronic Design Station

DATAQUEST believes that SC's most significant new product development is its Electronic Design Station (EDS), designed and manufactured by a majority-owned SC subsidiary, Accell Corporation of Rochester, New York. The EDS is a standalone computer and interactive graphics display. A dual-station EDS can be configured using a shared disk drive. All components are housed in a desk-sized cabinet and, in most cases, can be installed without any special preparations. Prices for the EDS range from $75,000 for a single station to $135,000 for a dual station.

MECANIX Program

The MECANIX program addresses electro-mechanical product packaging and design applications. MECANIX is based on proprietary technology licensed from N.V. Philips, and runs on the Digital Equipment VAX family of 32-bit minicomputers.

SC reported MECANIX is presently in Beta test. Shipments are expected to begin in the second quarter of 1984.

Design Services

SC's Design Services Group, founded in 1978, is a service bureau providing design services to SCICARDS users experiencing temporary work overflows, and to non-users on a per-job basis. Increasing demand for services has led to expansion of the Group from its Fishers, New York, headquarters. Additional service centers are located in Sunnyvale, California; Chicago, Illinois; Boston, Massachusetts; Dallas, Texas; London, England; and Paris, France.

The goals of the Group are to provide high-quality work at a rapid turnaround rate, as well as to establish and maintain close customer relationships. An added benefit to SC is the insight into printed circuit board technologies, as well as development of new techniques for using the SCICARDS system.

Electronic Design Automation System Interfaces

SC has developed and supports interfaces of its SCICARDS System to Daisy Systems, Mentor Graphics, Valid Logic, CAE Systems, and Futurenet products. The interface provides logic design and analysis capability.

SC is developing similar interfaces for its MEDS product.

Structural Dynamics Research Corporation

Structural Dynamics Research Corporation
2000 Eastman Drive
Milford, Ohio 45140
Telephone: (513) 576-2400
Corporate Financial Profile as of December 31
(Millions of Dollars except Per Share and Employee Data)

Balance Sheet Data	1984	1985	1986	CAGR 1984-1986
Working Capital	$ 6.1	$ 5.7	$ 5.2	(7.7%)
Long-Term Debt	$ 4.6	$ 4.2	$ 3.9	(7.9%)
Shareholders' Equity	$12.9	$14.6	$ 16.8	14.1%
After-Tax Return on Average Equity	31.0%	10.9%	11.9%	(38.0%)
Operating Performance				
Revenue	$36.3	$39.8	$ 51.6	19.2%
U.S. Revenue	$30.1	$32.9	$ 40.3	15.7%
Non-U.S. Revenue	$ 6.2	$ 6.9	$ 11.3	35.0%
Cost of Goods Sold	$17.9	$21.2	$ 23.4	14.1%
Gross Margin	$18.4	$18.6	$ 28.2	23.9%
Expenses	$13.7	$16.3	$ 24.3	33.2%
R&D Expense	$ 2.1	$ 2.6	$ 3.8	35.0%
SG&A Expense	$11.6	$13.7	$ 20.6	32.9%
Operating Income	$ 4.6	$ 2.3	$ 3.9	(8.8%)
Interest Income (Expense)	($ 0.6)	($ 0.5)	($ 0.5)	0
Income before Tax	$ 4.1	$ 1.8	$ 3.3	(9.8%)
Note: Pretax Margin	11.3%	4.5%	6.4%	(24.3%)
Taxes	$ 2.1	$ 0.3	$ 1.5	(16.5%)
Note: Effective Tax Rate	51.2%	16.4%	43.9%	(7.4%)
Net Income after Tax	$ 2.0	$ 1.5	$ 1.9	(3.3%)
Shareholder Data				
Average Shares Outstanding (Millions)	4.5	4.6	4.7	1.9%
Per Share Data				
Earnings	$0.44	$0.32	$ 0.40	(4.7%)
Dividends	0	0	0	0
Book Value	$2.83	$3.15	$ 3.56	12.2%
Price Range (Low)	N/M	N/M	N/M	N/M
(High)	N/M	N/M	N/M	N/M
Total Employees	N/A	N/A	579	N/M
Revenue Per Employee	N/A	N/A	$89,067	N/M

N/A = Not Available
N/M = Not Meaningful

Source: Structural Dynamics Research Corporation
Dataquest
February 1988

Structural Dynamics Research Corporation
2000 Eastman Drive
Milford, Ohio 45140
Telephone: (513) 576-2400
Line Items as a Percent of Revenue

Operating Performance

	1984	1985	1986
Revenue	100.0%	100.0%	100.0%
United States	83.0%	82.6%	78.2%
Non-United States	17.0%	17.4%	21.8%
Cost of Goods Sold	49.4%	53.3%	45.3%
Gross Margin	50.6%	46.7%	54.7%
Expenses	37.8%	40.9%	47.2%
R&D Expense	5.7%	6.5%	7.4%
SG&A Expense	32.1%	34.5%	39.9%
Other Expense	0	0	0
Operating Income	12.8%	5.8%	7.5%
Interest Income (Expense)	(1.5%)	(1.3%)	(1.1%)
Other Income (Expense)	0	0	0
Income before Tax	11.3%	4.5%	6.4%
Taxes	5.8%	0.7%	2.8%
Net Income after Tax	5.5%	3.8%	3.6%

Source: Structural Dynamics Research Corporation
Dataquest
February 1988

THE COMPANY

Founded

Structural Dynamics Research Corporation (SDRC) was founded in 1967 by a group of mechanical engineers from the University of Cincinnati to provide engineering consulting services. It is from this contact with the design community that SDRC's product line was developed and first marketed in 1971.

Positioning

SDRC sells and supports mechanical computer-aided engineering (MCAE) software and engineering consulting services for mechanical products. The entire company is engaged in supporting and developing this business. With $20 million in 1986 software sales to end users, SDRC attained a 2.7 percent share of the worldwide mechanical CAD software market.

SDRC's 1986 revenue by industry is as follows:

Aerospace and Defense	40%
Automotive	30
Industrial Manufacturing	30
Total	100%

SDRC's distribution of 1986 revenue by region is as follows:

North America	59%
Europe	26
Japan	14
Rest of World	1
Total	100%

FINANCIAL

Revenue

Revenue for the nine months ending September 30, 1987, was $37.0 million, with a corresponding profit of $0.8 million.

Financing

SDRC's initial public offering in September 1987 yielded the Company $13.9 million. The offering was underwritten by Morgan Stanley & Co., and Robertson, Colman & Stephens.

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- November 1987—SDRC announced the availability of drafting and finite element analysis software for the IBM RT PC.
- November 1987—SDRC announced that the I-DEAS line of MCAE software would be available on the CXP graphics workstations introduced by Sun Microsystems.
- September 1987—SDRC announced that I-DEAS was available on Digital Equipment's VAXstation 3200 and 3500.
- September 1987—SDRC announced an agreement with Interleaf, under which Interleaf's Workstation Publishing Software would be available for SDRC's I-DEAS Documentation System.
- September 1987—SDRC announced the availability of interfaces between I-DEAS and three ECAE systems—the Mentor Graphics Board Station, Scientific Calculations SCICARDS System, and Calma BOARDS Systems. The interfaces provide direct transfer of information from ECAE systems to I-DEAS in order to model and analyze PCB designs.
- July 1987—SDRC announced that I-DEAS would be available for the Apollo DN590 Turbo workstation.
- June 1987—SDRC estimated its cumulative installations at 4,566 comprising 1,441 design, 2,067 analysis, and 1,058 test units. The Company defined an installation as a single license of a module on a single computer system.
- February 1987—SDRC announced that I-DEAS would be available for Digital's VAXstation family of workstations.

ORGANIZATION

Personnel Distribution

As of June 30, 1987, SDRC employed 579 people, distributed as follows:

Research and Development	107
Sales and sales support	145
Marketing	40
Engineering services	235
General and administrative	52

CAD/CAM Organization

The Company maintains two business organizations: engineering services, which provides design and engineering services, and CAE International, which sells and supports the Company's MCAE software products.

MARKETING AND SALES

Strategy

For the last three years, SDRC's revenue from engineering services has approximately equaled its software product sales. The Company's engineering service business strategy is to create long-term partnerships with targeted companies whose mechanical product designs can provide the raw material for enhancements to the SDRC product line. SDRC's engineering services include consultation and expertise in design audits, product design, engineering process development, and design and manufacturing troubleshooting.

The synergy between SDRC's products and services substantially furthers the development of the Company's business. As a major user of the Company's software, the Engineering Services division provides insight into the MCAE software needs of design engineers and indirectly assures product quality and performance. In turn, the Company's MCAE software and open software architecture provide significant competitive advantages to the Engineering Services division.

SDRC has a solid foundation in its product, user base, and experienced staff. Like other MCAE vendors, the high technical content of the Company's product line creates significant barriers to entry by competitors. Dataquest believes that SDRC's major challenges will be to remain competitive as the MCAE marketplace shifts from the early adopter users to the mainstream engineering community, while it simultaneously continues development of high-end products for the traditional users.

Dataquest believes that key steps to SDRC's future growth will lie in:

- A more diverse customer base
- An enhanced user interface
- A low-end product offering

Distribution

SDRC sells its products through the Company's direct sales force, which has 25 offices located in Canada, England, France, West Germany, Italy, Japan, The Netherlands, and Sweden. SDRC also sells its products through distributors in Australia, the Republic of China, India, Israel, Japan, Korea, Switzerland, and Yugoslavia.

In addition to its direct sales force, SDRC maintains two other distribution channels: OEM agreements and reference selling or joint marketing. These alliances are reviewed in the "Strategic Alliances" section appearing later in this profile.

Dataquest estimates that SDRC's sales mix as a percent of revenue is as follows:

Direct sales	78%
OEM relationships	21
Distributors	1
Total	100%

SALES SUPPORT

Warranties

SDRC warrants its products for 90 days.

Maintenance Agreements

SDRC provides software maintenance on an annual fee basis. Maintenance includes phone hotline support and all upgrades to software and documentation, including those required because of changes made by a computer manufacturer.

Training

Training is offered in San Diego, Cincinnati, or at the user's site on request. Training courses typically require three days.

STRATEGIC ALLIANCES

OEM and Joint Marketing Agreements

SDRC licenses its software to IBM for IBM's subsequent relicensing under the name of CAEDS. Dataquest estimates that royalties from IBM were approximately 16 percent of SDRC's 1986 product revenue.

Calma Company is licensed to sell SDRC's product line directly to its end users. Dataquest estimates that this agreement contributed nearly five percent of SDRC's 1986 revenue.

SDRC maintains reference selling and joint marketing agreements with five computer manufacturers—Apollo, Digital, Genrad, Hewlett-Packard, and Sun—and five graphics terminal vendors—Evans & Sutherland, Megatek, Ramtek, Raster, and Tektronix.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- December 1986—SDRC estimated its year-end installed base at 3,000, 2,000 of which were Geomod installations. The Company estimated that Geomod was installed at 835 separate sites, and Supertab was installed at 850 sites.

- March 1986—SDRC and GE announced recombination of their joint venture, GE-CAE International. CAE International was formed in 1981 to sell and support SDRC software.

- March 1986—SDRC announced that I-DEAS would be available on Hewlett-Packard's Model 320 workstation.

- February 1986—SDRC announced the opening of a "test factory," designed to reduce vehicle development time. The privately owned automotive product validation center has eight automated road simulators.

- February 1986—The Company announced a software module for analysis of test data. Its capabilities include spectral, modal, statistical, fatigue analysis, and time history processing.
- March 1984—SDRC announced that I-DEAS would be available as part of Calma's turnkey systems.
- 1982—I-DEAS was first available through IBM under the name CAEDS.
- 1976—SDRC announced the first release of I-DEAS Supertab finite element modeling software.
- 1975—The Company introduced MODAL-PLUS software for users' in-house systems.
- 1971—SDRC announced its first software, FRAME and SUPERB, available on timesharing networks.

CAD/CAM PRODUCTS

The Company's products are summarized in Table 1. The pages following the table provide a detailed description of each product, with one product per page. These product pages are presented in the order in which they appear in Table 1.

Table 1

SDRC Products

Application Software

Model	Platform	Segment	Description
I-DEAS, Geodraw	Technical Workstation, Host-Dependent	Mechanical	Two-dimensional drafting; runs on computers from Apollo, Digital, Hewlett-Packard, IBM, and Sun
I-DEAS, Geomod	Technical Workstation, Host-Dependent	Mechanical	Solid modeling software; visualization capabilities include multiple-colored light sources, transparency, and multiple surface finishes
I-DEAS, Supertab	Technical Workstation, Host-Dependent	Mechanical	Finite element modeler with links to wide variety of analysis software
I-DEAS, Model Solution	Technical Workstation	Mechanical	Provides linear, static, dynamic, and potential flow analysis; includes finite element analysis; runs on Supertab

(Continued)

Table 1 (Continued)

SDRC Products

Model	Platform	Segment	Description
I-DEAS, Systan	Technical Workstation, Host-Dependent	Mechanical	Interactive analysis of the structural dynamic behavior of complex mechanical systems; systems are represented as an assembly of components defined from separate finite element analysis and Systan vibration analysis (including natural frequency, mode shape, and damped forced response); runs on Supertab
I-DEAS, Optimization	Technical Workstation, Host-Dependent	Mechanical	Solves mass reduction problems; runs on Supertab
I-DEAS, Tdas	Technical Workstation, Host-Dependent	Mechanical	Test data analysis system providing vibration, statistical, fatigue, spectral, and signal processing analyses
I-DEAS, Modal Plus	Technical Workstation, Host-Dependent	Mechanical	Functions include testing

Source: Dataquest
February 1988

CAD PRODUCT DESCRIPTION

Price: $2000

Model: I-DEAS, Geodraw
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation, Host-Dependent

CAD Application Software:
two-dimensional, drafting

Prerequisites:
Computer from Apollo, Digital, Hewlett-Packard, IBM, or Sun

Comments:
Annual licenses range from $2,000 to $14,000 depending on platform, configuration, and number of users. One time charge: $2,500 to $3,800

8709-2809-2838 SDRC

CAD PRODUCT DESCRIPTION

Price: $4700

Model: I-DEAS, Geomod
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation, Host-Dependent
Date of product introduction: 1983

CAD Application Software:
three-dimensional, solid modeling

Prerequisites:
Computer from Apollo, Digital, Hewlett-Packard, IBM, or Sun

Comments:
Solid modeling software. Visualization capabilities include multiple colored light sources, transparency, and multiple surface finishes. $4,700 to $31,000 annual license fee; $8,300 to $60,000 one-time charge depending on computer used and number of users

CAD PRODUCT DESCRIPTION

Price: $4700

Model: I-DEAS, Supertab
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation, Host-Dependent

CAD Application Software:
FEM/FEA

Comments:
Finite element modeler with links to wide variety of analysis software. Technical workstation pricing: $8,300 one-time charge; $4,700 annual license. Host-dependent pricing: $55,000 one-time charge; $31,200 annual license.

8709-2809-1750 SDRC

CAD PRODUCT DESCRIPTION

Price: $2300

Model: I-DEAS, Model Solution
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation, Host-Dependent

CAD Application Software:
FEM/FEA, other design/analysis

Prerequisites:
Supertab

Comments:
Provides linear, static, dynamic, and potential flow analysis. Pricing for technical workstation starts at $2,300.

8709-2810-3935 SDRC

CAD PRODUCT DESCRIPTION

Model: I-DEAS, Systan
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation, Host-Dependent

CAD Application Software:
other design/analysis

Prerequisites:
Supertab

Comments:
Interactive analysis of the structural dynamic behavior of complex mechanical systems. Systems are represented as an assembly of components defined from separate finite element analysis and Systan vibration analysis (including natural frequency, mode shape, and damped forced response)

0709-2009-3032 SDRC

CAD PRODUCT DESCRIPTION

Price: $1500

Model: I-DEAS, Optimization
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation, Host-Dependent

CAD Application Software:
other design/analysis

Prerequisites:
Supertab

Comments:
Solves mass reduction problems. Technical workstation pricing starts at $1,500.

8709-2810-3814 SDRC

CAD PRODUCT DESCRIPTION

Price: $3900

Model: I-DEAS, Tdas
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation, Host-Dependent

CAD Application Software:
testing

Comments:
Test data analysis system providing vibration, statistical, fatigue, spectral, and signal processing analyses. Prices range from $3,900 to $25,700 annual license or $6,800 to $45,000 one-time charge, depending on computer used and number of users

0709-2810-4023 SDRC

CAD PRODUCT DESCRIPTION

Model: I-DEAS, Modal Plus
Type: CAD Application Software for Mechanical Applications
Hardware Platform: Technical Workstation, Host-Dependent

CAD Application Software:
testing

8709-2810-4109 SDRC

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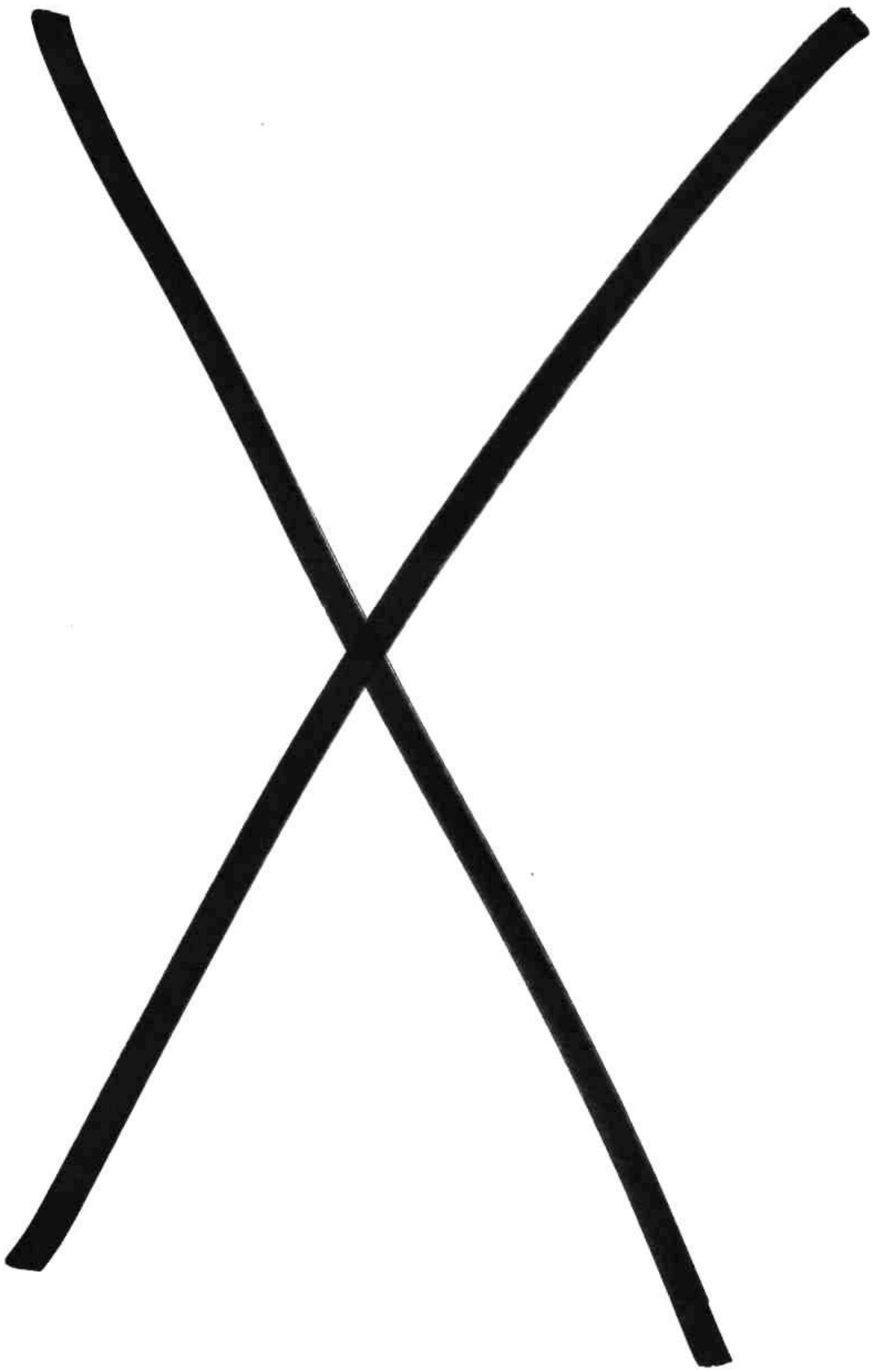

Synercom Technology, Inc.

Synercom Technology, Inc.
10405 Corporate Drive
Sugar Land, Texas 77478
Telephone: (713) 240-5000 Telex: 775619
(Millions of Dollars Except Per Share and Employee Data)

Corporate Financial Profile as of December 31

	1982	1983	1984	1985	1986	CAGR 1982-1986
Balance Sheet Data						
Working Capital	($3.2)	$3.9	($0.4)	$2.7	$19.9	N/M
Long-Term Debt	$1.0	$0.5	$0.5	$1.7	$0.4	(22.9%)
Shareholder's Equity	($1.6)	$6.1	$2.1	$3.7	$22.5	N/M
After-Tax Return on Average Equity	870.0%	(201.7%)	(124.5%)	55.6%	12.8%	
Operating Performance						
Revenue	$9.2	$9.5	$9.1	$17.0	$17.3	17.1%
U.S. Revenue	N/A	N/A	$7.8	$12.0	$11.3	N/M
Non-U.S. Revenue	N/A	N/A	$1.2	$5.0	$6.0	N/M
Cost of Goods Sold	$9.2	$7.0	$5.7	$6.8	$6.1	(9.8%)
Gross Margin	0.0	$2.5	$3.4	$10.2	$11.2	N/M
Expenses	$6.5	$6.5	$8.3	$8.2	$10.1	11.5%
R&D Expense	$2.9	$3.0	$3.5	$3.1	$2.8	(1.5%)
SG&A Expense	$3.6	$3.5	$4.8	$5.0	$7.4	19.4%
Other Expense	0.0	0.0	0.0	0.0	0.0	N/M
Operating Income	($6.6)	($4.0)	($4.9)	$2.0	$1.1	N/M
Interest Income (Expense)	($0.5)	($0.5)	($0.2)	($0.4)	$0.6	N/M
Other Income	0.0	0.0	0.0	0.0	0.0	N/M
Income before Tax	($7.0)	($4.5)	($5.1)	$1.6	$1.7	N/M
NOTE: Pretax Margin	($76.5)	($47.2)	($56.2)	$9.6	$9.7	N/M
Extraordinary Credit*	0.0	0.0	0.0	$0.7	$0.8	
Taxes	0.0	0.0	0.0	$0.7	$0.8	N/M
NOTE: Effective Tax Rate	0.0	0.0	0.0	41.6%	46.0%	N/M
Net Income after Tax	($7.0)	($4.5)	($5.1)	$1.6	$1.7	N/M
Shareholder Data						
Average Shares Outstanding (Millions)	872.6	1,346.0	1,383.0	5,016.4	6,032.4	62.2%
Per Share Data						
Earnings	N/A	($3.68)	($3.69)	$0.32	$0.28	62.2%
Dividends	0.0	0.0	0.0	0.0	0.0	N/M
Book Value	0.0	0.0	0.0	0.0	0.0	N/M
Price Range (Low)	N/A	N/A	N/A	N/A	5 1/4	
(High)	N/A	N/A	N/A	N/A	18 3/4	
Total Employees	N/A	N/A	N/A	162	178	N/M
Revenue Per Employee	N/A	N/A	N/A	$104,951	$97,331	N/M

N/A = Not Available
N/M = Not Meaningful
*Net operating loss carryforward

Source: Synercom Technology
Dataquest
July 1987

Synercom Technology, Inc.
10405 Corporate Drive
Sugar Land, Texas 77478
Telephone: (713) 240-5000 Telex: 775619

Line Items as a Percent of Revenue

	1982	1983	1984	1985	1986
Operating Performance					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
United States	0.0	0.0	86.3%	70.7%	65.3%
Non-United States	0.0	0.0	13.7%	29.3%	34.7%
Cost of Goods Sold	100.3%	73.9%	62.2%	39.8%	35.2%
Gross Margin	(0.3%)	26.1%	37.8%	60.2%	64.8%
Expenses	71.1%	67.7%	91.3%	48.2%	58.4%
R&D Expense	31.8%	31.3%	38.7%	18.5%	15.9%
SG&A Expense	39.3%	36.4%	52.5%	29.7%	42.5%
Other Expense	0.0	0.0	0.0	0.0	0.0
Operating Income	(71.3%)	(41.6%)	(53.5%)	12.0%	6.4%
Interest Expense (Expense)	(5.1%)	(5.6%)	(2.6%)	(2.4%)	3.4%
Other Income (Expense)	0.0	0.0	0.0	0.0	0.0
Income before Tax	(76.5%)	(47.2%)	(56.2%)	9.6%	9.7%
Taxes	0.0	0.0	0.0	4.0	4.5%
Net Income after Tax	(76.5%)	(47.2%)	(56.2%)	9.6%	9.7%

Source: Synercom Technology
Dataquest
July 1987

THE COMPANY

Founded

Synercom was founded in Sugar Land, Texas, in 1969.

Positioning

Synercom sells and supports software for mapping applications, and derives all its revenue from CAD/CAM markets. The Company's performance and market share history is shown in Table 1. Dataquest ranks Synercom as number two in the 1986 CAD mapping software market.

Table 1

Synercom Technology CAD/CAM Performance
(Millions of Dollars)

	1985	1986
Revenue	$17	$17
Mapping Segment Market Share Percentage	7%	5%

Source: Dataquest July 1987

FINANCIAL

Synercom's revenue for the first six months of 1987 was $3.9 million, with a net loss of $2.9 million.

Financing

In March 1986, Synercom completed an initial public offering underwritten by Morgan Stanley and Robertson, Colman & Stephens. Net proceeds to the Company were $17.4 million.

From July 1981 to October 1983, the Company received $20.5 million in venture capital from several sources, including The Adler Group; Robertson, Colman & Stephens; IBM Retirement Fund; and GE Pension Trust.

HIGHLIGHTS

Listed below in reverse chronological order are recent company highlights:

- December 1986—The Company appointed AT&T Technologies as its first U.S. distributor.
- April 1986—Synercom became a public company.
- 1986—The Company introduced a distributed automated mapping/facilities management software product line called Informap III.

ORGANIZATION

Personnel Distribution

The Company's 178 employees are distributed as follows:

Department	Percentage of Employees
R&D/Engineering	23%
Marketing	20%
Sales	20%
Field Support	12%
Administration/Other	25%
Total	100%

Facilities

Synercom occupies approximately 56,000 square feet of office, manufacturing, and warehouse space in Sugar Land, Texas.

MARKETING AND SALES

Strategy

Synercom sells its software primarily to large organizations that require extensive mapping and geographic information, such as telephone companies, electric and gas utilities, governments, and natural resources organizations. The Company devotes a major portion of its R&D and marketing efforts to the telephone industry.

During the past year, the Company's financial performance has suffered, and Synercom does not project short-term improvement. We believe these financial setbacks are partially due to the Company's transition from turnkey sales to a software-only product line.

Distribution

Synercom sells its systems through a direct sales force in 15 U.S. cities, Canada, and Switzerland. In addition, the Company sells through distributors in 21 offices in other countries.

In December 1986, Synercom appointed AT&T Technologies as a nonexclusive distributor of products in the United States.

SALES SUPPORT

Maintenance Agreements

The Company offers software maintenance on either a monthly fee or an on-call basis. The monthly maintenance plan includes software updates and telephone assistance. Synercom also offers turnkey maintenance agreements based on subcontracts with the hardware manufacturers.

Training

Training is offered at Synercom headquarters or at the customer's site. Typical training courses are one to three days long.

Applications Support

The Company offers consulting services for assistance in developing customer-specific applications software.

STRATEGIC ALLIANCES

OEM Agreements

Synercom's EMIS product is based on the Odyssey geographical information systems (GIS) mapping software developed by the Harvard Computer Graphics Laboratory and licensed by Synercom.

Synercom has a joint marketing agreement with Digital Equipment for various computers and workstations.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- 1985—Synercom introduced an integrated automated mapping/facilities management system called Informap II.
- August 1984—Synercom and Tektronix announced a cooperative marketing agreement under which Synercom will work to jointly market INFORMAP software on Tektronix' graphics terminals.
- 1983—Synercom began its transition from turnkey to unbundled supplier, and started offering its software and host-dependent workstations separately from the Digital Equipment computers on which they operate.
- 1981—The Company began porting its mapping software to Digital Equipment's VMS operating system.
- 1979—Synercom introduced the geographically related data base management system.
- 1972—Synercom entered the automated mapping market.
- 1969—Synercom was founded.

CAD/CAM PRODUCTS

The Company's products are summarized in Table 2. The pages following this table provide a detailed description of each product, with one product per page. These product pages are presented in the order in which they appear in Table 2.

Table 2

Synercom Products

Application Software

Model	Platform	Segment	Description
Informap III	Host-dependent, technical workstation	Mapping	Core mapping data base management software for distributed processing environments. Functions include drafting, subsurface, utilities, contours, map conversion, GIS, facilities management, production planning. Runs on VAX 8XXX with BI bus, MicroVAX II, or VAXstation II. Communicates with earlier Informap II via Informaster.
EMIS	Host-dependent, technical workstation	Mapping	Environmental Mapping Information System (EMIS). GIS package for manipulation and analysis of Informap data base and associated statistical attributes; displays the spatial distribution of the attributes in thematic maps. Runs on Informap software.
1st Map	Host-dependent, technical workstation	Mapping	Group of vertical-market products that contain a defined data base, menus, symbol tables, and sample data: designed to reduce start-up time for new customers. Runs on Digital Equipment computer.
OPIS	Host-dependent, technical workstation	Mapping	Outside Plant Information System (OPIS). Automates the mapping and recordkeeping of a telephone company's outside plant assets. Runs on Informap and Plus.
Plus	Host-dependent, technical workstation	Mapping	Group of graphics and data management routines that aid in developing industry-specific Informap applications.

Other Software

Model	Platform	Type	Description
Infodapt	PC, host-dependent	Miscellaneous	Terminal emulation software for IBM PC and Tektronix 4100 series. Runs on host computer.

Source: Dataquest
July 1987

CAD PRODUCT DESCRIPTION

Price: $55000

Model: Informap III
Type: CAD Application Software for Mapping Applications
Hardware Platform: Technical Workstation, Host-Dependent
Date of product introduction: 10/86

System Configuration:

Manufacturer: Digital Equipment
Operating System: VMS

Workstation Configuration:

Manufacturer: Digital Equipment

CAD Application Software:
drafting, subsurface, utilities
contours, map conversion, GIS
facilities management, production planning

Language used: FORTRAN, C

Prerequisites:
VAX 8XXX on BI bus, MicroVAX II, or VAXstation II

Comments:
Core mapping data base management software. Informap III is for distributed processing environments; networked distributed systems require Informaster data management package. Price is entry level for Informap III ($35,000) and Informaster ($20,000)

8706-8313-1117 SYNERCOM

CAD PRODUCT DESCRIPTION

Model: Informap II
Type: CAD Application Software for Mapping Applications
Hardware Platform: Host-Dependent
Date of product introduction: 1972

System Configuration:

Manufacturer: Digital Equipment
Operating System: VMS

Workstation Configuration:

Manufacturer: Digital Equipment

CAD Application Software:
drafting, subsurface, utilities
contours, map conversion, GIS
facilities management, production planning

Language used: FORTRAN, C

Prerequisites:
VAX 8XXX or MicroVAX on Unibus

Comments:
Core mapping data base management software for host-based systems.
Communication with Informap III is via Informaster

8706-0313-1118 SYNERCOM

CAD PRODUCT DESCRIPTION

Model: EMIS
Type: CAD Application Software for Mapping Applications
Hardware Platform: Host-Dependent, Technical Workstation
Date of product introduction: 10/85

System Configuration:

Operating System: VMS

CAD Application Software:
GIS, three-dimensional

Language used: FORTRAN

Prerequisites:
Informap

Comments:
Environmental Mapping Information System (EMIS) provides manipulation and analysis of Informap data base and associated statistical attributes, and displays the spatial distribution of the attributes in thematic maps

0706-0313-2042 SYNERCOM

CAD PRODUCT DESCRIPTION

Model: 1st Map
Type: CAD Application Software for Mapping Applications
Hardware Platform: Host-Dependent, Technical Workstation

System Configuration:

Operating System: VMS

Prerequisites:
Digital Equipment computer

Comments:
1st Map is a group of vertical-market products that contain a defined data base, menus, symbol tables, and sample data. It is designed to reduce start-up time for new customers.

0786-0313-3216 SYNERCOM

CAD PRODUCT DESCRIPTION

Model: OPIS
Type: CAD Application Software for Mapping Applications
Hardware Platform: Host-Dependent, Technical Workstation

System Configuration:

Operating System: VMS

CAD Application Software:
utilities

Language used: FORTRAN

Prerequisites:
Informap and Plus

Comments:
Outside Plant Information System (OPIS) automates the mapping and record keeping of a telephone company's outside plant assets.

8706-0313-2456 SYNERCOM

CAD PRODUCT DESCRIPTION

Model: Plus
Type: CAD Application Software for Mapping Applications
Hardware Platform: Host-Dependent, Technical Workstation

System Configuration:

Operating System: VMS

Prerequisites:
Informap

Comments:
Plus is a group of graphic and data management routines that aid in developing industry-specific Informap applications.

0786-0313-2721 SYNERCOM

CAD PRODUCT DESCRIPTION

Model: Infodapt
Type: Miscellaneous Software for Mapping Applications
Hardware Platform: PC, Host-Dependent

System Configuration:

Operating System: VMS

Prerequisites:
Informap and Digital Equipment VAX

Comments:
Infoadapt is terminal emulation software for IBM PC and Tektronix 4100 series. It runs on a host computer.

8706-0314-3828 SYNERCOM

Synercom

Synercom
P.O. Box 27
Sugar Land, Texas 77478
Telephone (713) 491-5000 Telex 775619

(Synercom is a privately held company; therefore, no financial data are available.)

Synercom

THE COMPANY

Background

Synercom was founded in Sugar Land, Texas, in 1969. It is a privately held company engaged in the development and marketing of mapping and information management software and mapping workstations.

Highlights

June 1984--Synercom released INFOTRACE/E, an automated circuit trace and switching system software package.

July 1984--The Company donated a computerized mapping system to the state of Texas.

August 1984--Synercom and Tektronix announced a cooperative marketing agreement under which Synercom will work to jointly market INFORMAP II mapping information management software on Tektronix's series 4100 graphics terminals.

October 1984--The Company finalized a distributorship agreement with Nissho Electronics Corporation of Japan to distribute Synercom's mapping information management software and workstations in Japan. (Nissho Electronics is an independent arm of Nissho Iwai Corporation, an international trading company.)

Synercom recently raised more than $20 million in venture capital through placement of preferred stock. The funds will be used to expand the Company's marketing, sales, and product development staffs and to add to the existing product lines.

As a result of the Company's aggressive third-party marketing campaign, DATAQUEST believes that Synercom will continue to be a major force in the mapping information management CAD/CAM segment.

Organization

Synercom's corporate headquarters are located at its 64,000-square-foot facility in Sugar Land, Texas. The Company's international offices are located in Switzerland and Canada. Both of these offices are full service sales and support facilities.

Synercom

Synercom has 179 employees, many of whom serve in a variety of capacities among the Company's various departments. For more information on the functionality of Synercom's employees, refer to Table 1.

Table 1

EMPLOYEES BY DEPARTMENT

Department	Number of Employees	Functionality
Marketing and Sales	48	Outside sales; interface with R&D
Software Support	33	Programming; work with customer to customize product
Research and Development	78	Product development; manufacturing
Customer Service	23	Hardware/software support in conjunction with 800 telephone number
Administrative	40	Corporate support
Total Employees	179*	

*Numbers shown do not add to this total due to overlapping responsibilities of employees.

Source: DATAQUEST

Synercom

Research and Development

Synercom's research and development department is located at its corporate headquarters in Sugar Land. Although the majority of the 78 people in product development are primarily involved with application software, the Company is also continuing to develop workstations to support its mapping software.

The Company is concentrating its research and development efforts on expanding its applications software within the mapping information management segment.

Manufacturing

Synercom's manufacturing facilities are also located at its corporate offices. Approximately 12 people are involved in manufacturing Synercom's graphics workstations.

Marketing and Sales

Synercom has seven sales offices in the United States at the following locations:

- Atlanta, Georgia
- Austin, Texas
- Cleveland, Ohio
- Indianapolis, Indiana
- Los Angeles, California
- Orlando, Florida
- San Francisco, California

There are 48 people in the Company's marketing and sales group, 10 of whom work closely with the reseach and development department to customize products for individual customers.

Support

Synercom's Customer Service Division has 25 people involved in maintenance and support. Six of these people are responsible for software support, and the remaining 19 are involved in field service. Synercom's customer support includes two user-witnessed inspection and acceptance tests conducted by Synercom technicians on each system. The Company also has a comprehensive training program that includes initial system generation and management training at its headquarters facilities in Sugar Land. Operator training is conducted at users' facilities following installation; these ten-day workshops consist of both instruction and hands-on experience.

A system update service that includes new features and program changes is maintained annually on a contract basis. In addition to scheduled periodic maintenance, Synercom has an 800 telephone number that is available to customers on a 24-hour basis for consultation with on-call support personnel.

The Company has seven service and support offices in the United States at the following locations:

- Anchorage, Alaska
- Boston, Massachusetts
- Kansas City, Missouri
- Oklahoma City, Oklahoma
- Sacramento, California
- San Antonio, Texas
- Sugar Land, Texas

CAD/CAM PRODUCTS

Base Software

- Synercom's core product for its mapping information management system is INFORMAP II, a layered, VAX-based software product that allows users to build mapping systems in phases.

- Level one, INFOMAPPER, provides mapping graphics and data base management functions. Level two, INFOMANAGER, adds enhanced data base management and manipulation capabilities. Level three, INFOQUEST, adds enhanced report writing capabilities.

- MICRO-MAPPER is Synercom's special-purpose information processing system that is built around a micro version of INFORMAP II. MICRO-MAPPER runs on Digital Equipment's MicroVAX. Each system consists of a series of solutions designed to meet specialized needs of specific users.

- Synercom's 1ST MAP packages are ready-to-use data base design tools, graphic display tables, command menus, documentation, INFORMAP II routines, and other productivity tools. 1ST MAP allows users to bypass the normal data base definition phase.

- INFODAPT is an interface between the INFORMAP II data base and various office automation-type workstations and terminals. These include the IBM PC and the Tektronix 4100 Series.

- LIBERATOR offers the capacity to run Synercom software on an Intergraph VAX-based system. It provides the graphics and data base management functions of INFOMAPPER, interfaces between the data base and third-party terminals, and provides a standard interchange format for converting from Intergraph to Synercom format.

- Table 2 contains information regarding Synercom's INFORMAP II systems, workstations, and application software.

Table 2

SYNERCOM PRODUCTS

SYSTEMS

Name	Manufacturer	Word Size	Workstations Supported
VAX 11/785	Digital Equipment	32-bit	15
VAX 11/780	Digital Equipment	32-bit	12
VAX 11/750	Digital Equipment	32-bit	8
VAX 11/730	Digital Equipment	32-bit	4
VAX 11/725	Digital Equipment	32-bit	2
MicroVAX II	Digital Equipment	32-bit	1

WORKSTATIONS

Name	Type	Resolution	Number of Colors
GWS IV	Host-dependent	1,280 x 1,024	8
IBM PC	Host-dependent	640 x 480	Monochrome

APPLICATIONS SOFTWARE

Name	Description
OPIS/3	Telephone Outside Information Software that adds to INFORMAP II automation of engineering design and analysis; includes cable throw and cable fill calculations
EMIS	Environmental Mapping Information Software designed for cartographic-quality geographic information management functions
INFOTRACE/E	A system for performing analytical operations on a data base that contains electrical facilities elements
ALIGN	For production of engineering drawings of linear futures such as pipelines, transmission lines, and highways
CIP	A package for contour interpolation by digital terrain models
TERRAIN ENGINEERING	A modular group of subsystems that access INFORMAP II to perform functions such as road design and mass haul computation
PAC/IN	A plan, profile, and cross-section package comprising a comprehensive set of INFORMAP II macros and Fortran programs
CARTRAN	A coordinate transformation package that enables transfer from one supported map projection to another

Source: DATAQUEST

SILVAR-LISCO

THIS IS A TEMPORARY TAB WHICH WILL

BE REPLACED WITH A PERMANENT TAB SHORTLY

Silvar-Lisco

Silvar-Lisco
1080 Marsh Road
Menlo Park, California 94025
Telephone: (415) 324-0700 TWX: 910/373-2056
(Millions of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF APRIL 30

	1983	1984	1985	CAGR 1983-1985
BALANCE SHEET DATA				
Working Capital	$ 2.3	$ 1.4	$ 8.1	87.5%
Long-Term Debt	$ 0.8	$ 1.2	$ 1.1	18.6%
Shareholders' Equity	$ 3.4	$ 2.9	$ 1.1	(43.9%)
After-Tax Return on Average Equity	N/A	256.3%	405.7%	
OPERATING PERFORMANCE				
Revenue	$ 4.3	$11.1	$15.6	90.0%
U.S. Revenue	$ 2.8	$ 6.8	$ 9.8	86.9%
Non-U.S. Revenue	$ 1.5	$ 4.3	$ 5.7	95.7%
Cost of Goods Sold	$ 0.0	$ 0.5	$ 0.9	2,964.3%
Gross Margin	$ 4.3	$10.6	$14.6	84.2%
Expenses	$ 3.0	$ 7.3	$13.5	112.1%
R&D Expense	$ 1.5	$ 3.3	$ 5.9	99.8%
SG&A Expense	$ 2.4	$ 6.1	$ 9.4	98.2%
Other Expense	($ 0.9)	($ 2.1)	($ 1.7)	42.2%
Operating Income	$ 1.3	$ 3.3	$ 1.1	(7.3%)
Interest Expense	($ 0.2)	($ 0.3)	($ 0.3)	24.3%
Interest Income	$ 0.0	$ 0.0	$ 0.6	N/M
Other Income (Expense)				
Income before Tax	$ 1.5	$ 3.5	$ 2.0	15.8%
NOTE: Pretax Margin	34.2%	31.6%	12.7%	
Taxes	$ 0.1	($ 0.2)	($ 0.2)	N/M
NOTE: Effective Tax Rate	4.5%	(7.1%)	(8.3%)	N/M
Net Income after Tax	$ 1.4	$ 3.8	$ 2.1	23.4%
SHAREHOLDER DATA				
Average Shares Outstanding (Millions)	4.0	4.6	6.1	24.2%
Per Share Data				
Earnings	$0.06	$0.15	($0.07)	N/M
Dividends	$0.00	$0.00	$0.00	0%
Book Value	$0.84	$0.63	$0.17	(54.8%)
Price Range (Low)	N/A	N/A	3 1/8-	
(High)	N/A	N/A	6 3/8	
TOTAL EMPLOYEES	59	154	211	89.1%
Revenue Per Employee	$ 0.1	$ 0.1	$ 0.1	0.5%

N/A = Not Available
N/M = Not Meaningful

Source: Silvar-Lisco Annual Reports and Forms 10-K

Silvar-Lisco

Silvar-Lisco
1080 Marsh Road
Menlo Park, California 94025
Telephone: (415) 324-0700 TWX: 910/373-2056
(Millions of Dollars Except Per Share Data)

LINE ITEMS AS A PERCENT OF REVENUE

	1983	1984	1985
OPERATING PERFORMANCE			
Revenue	100.0%	100.0%	100.0%
U.S. Revenue	65.3%	61.6%	63.1%
Non-U.S. Revenue	34.7%	38.4%	36.9%
Cost of Goods Sold	$0.0	$0.0	$0.1
Gross Margin	$1.0	$1.0	$0.9
Expenses	69.6%	65.9%	86.7%
R&D Expense	34.0%	29.8%	37.6%
SG&A Expense	55.3%	54.6%	60.2%
Other Expense	(19.7%)	(18.5%)	(11.1%)
Operating Income	30.4%	29.4%	7.2%
Interest Expense	(3.8%)	(2.3%)	(1.6%)
Interest Income	0.0%	0.0%	0.0%
Other Income (Expense)	0.0%	0.0%	0.0%
Income before Tax	34.2%	31.6%	12.7%
Taxes	1.6%	(2.2%)	(1.1%)
Net Income after Tax	32.7%	33.9%	13.8%

Source: Silvar-Lisco Annual Reports and Forms 10-K
DATAQUEST

Silvar-Lisco

THE COMPANY

Background

Silvar-Lisco develops, markets, and supports a broad line of modular electronic design automation (EDA) software products, hosted by various mainframe computers and standalone workstations. The Company supplies designers of integrated circuits and systems with tools that address the electronic design cycle, including schematic capture, simulation, and layout. The Company resulted from the merger in April 1981 of Silicon Valley Research Incorporated (Silvar) and the predominantly Belgian-owned Leuven Industrial Software Company (Lisco), both founded in 1979. Silvar-Lisco began operations on May 1, 1981.

Highlights

The following are highlights of recent Company events, presented in reverse chronological order:

- August 1985--The Company signed a distribution agreement with China Computer Company of Taiwan for representation in Taiwan.
- June 1985--The Company signed a distribution agreement with Doosan Computer Company of Korea for representation in Korea.
- June 1985--The Company announced a cooperative technology and marketing agreement with Zycad Corporation for an integrated software/hardware verification system.
- June 1985--The Company announced an OEM agreement with Optima Technology and SECMAI S.A. whereby the Company will market OPTIMATE, a PCB layout software package, in North America and Europe.
- February 1985--The Company formed a subsidiary, Nihon Silvar-Lisco, as a joint venture with NED, an affiliate of the Company's former Japanese distributor, C. Itoh.
- September 1984--The Company opened a southeast U.S. regional sales and support office in Atlanta, Georgia.
- May 1984--The Company announced its initial public offering consisting of 22.2 million shares of common stock.

Silvar-Lisco

Organization

Silvar-Lisco's U.S. and corporate headquarters in Menlo Park, California, houses administration, marketing, engineering, research and development, and support activities. A facility in Leuven, Belgium, houses administration, marketing, engineering, research and development, and support activities for the European marketplace. The Company leases the Menlo Park facility, which consists for 34,290 square feet of office space. The Company occupies 9,000 square feet in Leuven, Belgium, also under lease. As of April 30, 1985, the Company employed 211 persons worldwide.

Research and Development

The Company's research and development (R&D) efforts are divided between the U.S. and Belgian facilities. The Menlo Park R&D group has primary responsibility for design entry, digital simulation, and gate array layout products; quality assurance; systems management; and engineering services. The Leuven-based R&D activities primarily focus on standard cell layout and analog simulation tools. Approximately a third of the Company's engineering and R&D personnel reside in Europe.

Future joint technology development plans include various IC design verification products in conjunction with Zycad, as well as PCB layout products based on Optimate software from Optima Technology, the U.S. affiliate of the French company SECMAI S.A. (Silvar-Lisco is a licensed distributor for Optimate on VAX/VMS.) The Company is also planning PC AT-based products.

Table 1 lists the Company's research and development expenses as a percentage of revenue. These expenses also reflect ongoing engineering costs, including software generation and maintenance, as well as product development.

Silvar-Lisco

Table 1

Silvar-Lisco
RESEARCH AND DEVELOPMENT EXPENSES
(Millions of Dollars)

	1981	1982	1983	1984	1985*
Revenue	0.3	1.8	4.3	11.1	15.6
R&D Expense	0.2	0.5	1.5	3.3	5.9
R&D Expense (as a Percent of Revenue)	47%	27%	34%	30%	38%

*Note: Data are for fiscal years ended April 30

Source: Silvar-Lisco

Manufacturing

The Company's manufacturing activities consist of software configuration, generation, and documentation. The Company is a hardware OEM for Apollo workstations, Tektronix graphics terminals, and Hewlett-Packard plotters. It also performs systems integration on this hardware.

Marketing and Sales

The Company markets its products directly in the United States and Western Europe, through a joint venture in Japan, and through distributors in Taiwan and Korea. The Company's primary marketing efforts focus on integrated circuit vendors, large electronic systems manufacturers, and major aerospace, automotive, and consumer electronics companies. Approximately 80 individuals comprise the Company's worldwide sales and support force.

Silvar-Lisco has a cooperative marketing agreement with Digital Equipment Corporation by which Digital sales personnel recommend the Company's software products in combination with Digital hardware as a solution for electronic design activities. Digital also distributes Silvar-Lisco product information and invites the Company's sales force to work jointly with it on accounts.

Silvar-Lisco

The Company's domestic sales offices are located in the following cities:

- Phoenix, Arizona
- Los Angeles, California
- Sunnyvale, California
- Atlanta, Georgia
- Plymouth, Michigan
- Minneapolis, Minnesota
- Nashua, New Hampshire
- East Brunswick, New Jersey
- Dallas, Texas

The Company's international sales offices are located in the following cities:

- Leuven, Belgium
- London, England
- Paris, France
- Milan, Italy
- Tokyo, Japan
- Stockholm, Sweden
- Munich, West Germany

Support

The Company maintains nine Technical Support Centers (TCSs), which provide both pre-sale and post-sale technical field support in addition to direct sales support. Fifteen individuals participate as trainers, including eight full-time trainers. Training at the Menlo Park facility is primarily limited to OEM and company-internal training. The Company's Technical Support Centers are located in the following cities:

- Leuven, Belgium
- Los Angeles, California
- Menlo Park, California
- Sunnyvale, California
- London, England
- Paris, France
- Minneapolis, Minnesota
- Nashua, New Hampshire
- Munich, West Germany

Silvar-Lisco

MAJOR HISTORICAL MILESTONES

The Company's major historical events are listed below, in reverse chronological sequence:

- February 1985--The Company formed a subsidiary, Nihon Silvar-Lisco, as a joint venture with its former Japanese distributor, C. Itoh.

- March 1984--The company relocated its corporate headquarters from Palo Alto, California, to new facilities in Menlo Park, California.

- October 1983--The Company began marketing the HELIX behavioral simulator.

- April 1983--The Company announced the Starline series of turnkey systems for IC and system-level design based on Apollo workstations.

- March 1983--The Company received $1.65 million in funding from Citicorp Venture Capital Ltd. and Union Venture Corporation.

- February 1983--The Company signed a distribution agreement with C. Itoh Data Systems of Tokyo for representation throughout Japan.

- January 1983--The Company introduced the SL-2000 integrated software system.

- April 1981--The Company was formed as the result of a merger between Silicon Valley Research Incorporated and Leuven Industrial Software Company. The Company's first product for semicustom IC physical layout actually began shipping in 1980.

Silvar-Lisco

CAD/CAM PRODUCTS

The Company's product offerings combine design capture and verification software for use in the product definition, system design, and logic design stages of the electronic design cycle along with physical layout software for semicustom integrated circuits and printed circuit boards. The Company's products are modular and communicate by means of a shared, hierarchical data base. Individual software products can be based on systems from other EDA vendors. Table 2 lists Silvar-Lisco's application software products. The Company also markets Apollo workstations, Tektronix graphics terminals, and Hewlett-Packard plotters via OEM agreements with those manufacturers.

The Company also offers other products to support electronic designers in the areas of functional and block diagram specification, circuit simulation, and documentation.

Silvar-Lisco has a licensing agreement with NCA Corporation for software for layout verification and artwork generation, including design rule checking, netlist/layout comparison, and pattern generator tape preparation. The Company markets graphics terminals under an OEM agreement with Tektronix, Inc., and plotters under an OEM agreement with Hewlett-Packard Company.

Table 2

Silvar-Lisco
APPLICATION SOFTWARE PRODUCTS

Design Phase	Product	Description
Design capture	SDS	Structured design entry system for creating and modifying the design data base; includes CASS (schematic editor), HIDEX (hierarchical design expander), and HIPAR (hierarchical design management tool for partitioning logic designs into physical packages)
Design verification	HELIX	Behavioral simulation system for the specification and simulation of complete systems, functional blocks, or logical elements; includes LOGAN
	LOGAN	Interactive display post-processor for simulation results
	ANDI	Mixed mode (analog and digital) circuit, timing, and logic simulation for MOS devices
	SWAP	Switched-capacitor simulation system
	BIMOS	Logic simulation system for NMOS and CMOS; includes LOGAN
Design Layout	CAL-MP	Standard cell layout system with automatic/interactive placement and routing
	GARDS	Gate array layout system with automatic/interactive component placement and interconnection routing, and interactive routing editing
	OPTIMATE	Automatic/interactive printed circuit board component placement and routing

Source: DATAQUEST

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Telesis Systems Corporation

TELESIS SYSTEMS CORPORATION

Telesis Systems Corporation
21 Alpha Road
Chelmsford, Massachusetts 01824
(617) 256-2300

Telesis Systems Corporation is a privately held company; therefore, balance sheet and income statement data are unavailable.

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THE COMPANY

Background

Telesis Systems Corporation was founded in January of 1981 in Chelmsford, Massachusetts. Originally, the Company was engaged in the development and marketing of standalone printed circuit board CAD/CAM systems. It has since expanded its applications scope to encompass front-end electronic design automation and mechanical CAD applications software. Telesis' end-user market is comprised of the computer, consumer electronics, telecommunications, design service bureau, and defense industries. As of February 1986, the Company had an installed base of 437 workstations at 230 customer sites.

Highlights

Listed below in reverse chronological order are Company highlights for the past year:

- February 1986—Telesis Systems introduced the EDA-620 Routing Accelerator, which is based on Sun Microsystems' SUN III hardware architecture, for use with the EDA-300 and -700 design workstations.
- January 1986—The Company received $7 million from its existing private investors in its fifth round of financing. This round of financing brought the Company's total capitalization to $26.5 million.
- August 1985—Telesis received $6 million in its fourth round of financing, secured by investment groups such as Concord Partners; Innoven II Corporation; and Welsh, Carson, Anderson, and Stowe.
- June 1985—The Company introduced the ECL Toolbox, a software package for the design of high-frequency digital PCB systems.
- June 1985—Telesis introduced the EDA-700 Design Workstation, a workstation for PCB and mechanical applications.
- April 1985—The Company announced the availability of the Telesis Thermal Analyzer, a software package for thermal analysis of PCB and packaging design applications.
- February 1985—Telesis made several product introductions, which included the following:
  - The EDA-3000 PCB Design Application, a PCB design software package featuring capabilities such as automatic gate and pin assignment and a new placement improvement algorithm.

- The EDA-1000 Design Capture System, a personal-computer-based schematic capture product consisting of a graphics card and optical mouse along with back annotation capabilities and automatic data exchange capabilities from Telesis workstations through netlist transfer

- The EDA-500 Remote Processing Unit, designed to off-load computationally intensive tasks from Telesis workstations

Organization, Marketing, and Sales

Telesis maintains its corporate headquarters at an 82,000-square-foot facility located in Chelmsford, Massachusetts. The Company has eight district offices, at the following locations:

- Chelmsford, Massachusetts
- Fountain Valley, California
- Irving, Texas
- Iselin, New Jersey
- Phoenix, Arizona
- Santa Clara, California
- Schaumberg, Illinois
- Tampa, Florida

All of Telesis' district offices are full sales, demonstration, and customer support centers. In addition, the Company has sales-only offices located in Lilburn, Georgia; San Diego, California; and Phoenix, Arizona.

Outside of the United States, the Company markets its products through an international agreement with Largo Computers in Israel. Additionally, the Company has a two-year agreement with Tokyo Keiki, Ltd., to distribute Telesis' workstations in Japan. The two companies are jointly developing software and hardware modifications to incorporate the Japanese language and design standards into the Telesis systems.

As of March 1, 1986, the Company employed 142 people. Please refer to Table 1 for details of employee distribution by departments.

Table 1

Telesis Systems Corporation
Employees by Department

Research and Development	39
Marketing and Sales	55
Customer Support	20
Manufacturing	11
Administration	17
Total	142

Source: Telesis Systems Corporation

Research and Development

Telesis' research and development (R&D) activities are conducted at its headquarters in Chelmsford. Approximately 80 percent of the 39 people involved in the Company's R&D are dedicated to applications software development. Another 10 percent are involved in the development of workstations, and the remaining 10 percent interface with both hardware and software development engineers.

The Company will continue to develop a wide range of applications products, including mechanical applications software, logic simulation, timing analysis, thermal analysis, and enhancements to existing products.

Manufacturing

Approximately 7 percent of the Company's employees, or 11 people, are involved in the manufacturing of its products. Telesis maintains its manufacturing facilities at its Massachusetts headquarters. The Company's primary manufacturing activities involve assembling, integration, and testing of major system components.

Support

After the sale of a system, an applications support coordinator works with the customer through the installation and training of the staff who will be using the system.

Credits for training courses are included in the system purchase price. There are four basic courses available to customers:

- PCB design (five days)
- Mechanical design (five days)
- Schematic drafting (four days)
- Managers' seminars (three days)

There is no training course available for the Company's EDA products; Telesis views the EDA-1000 as self-tutorial. However, the Company will send an applications engineer to the customer site on the date of installation to work with the intended operator on the system. Also, there is a manual available with the system.

Customer support includes a 90-day warranty from the date of installation on the system(s) purchased. This may then be followed by an ongoing, annually renewable maintenance agreement that includes free software upgrades and a modem connection via an 800 number to Telesis' corporate support department. The modem connection allows the customer to call the Company and then enables the applications engineer to pinpoint the problem by looking at the system via the modem, thus shortening the problem-solving cycle.

The Company provides maintenance on all systems. When the customer has purchased the hardware (the IBM PC or Digital Equipment Corporation LSI products) through another source, Telesis offers the option of transferring maintenance services to the Company or continuing to have the hardware serviced by the original source.

MAJOR HISTORICAL MILESTONES

Below is a reverse chronological list of the events that have shaped Telesis' history as a CAD/CAM company, up to its most recent fiscal year:

- February 1985—Telesis announced its first electronic design automation products with its EDA-10, -20, and -30 systems products based on the IBM PC family
- February 1985—The Company introduced the EDA-6000 coprocessor
- July 1984—Telesis formed a $4.6 million research and development limited partnership with Kidder, Peabody, & Co., Inc.

- July 1984—Telesis released enhanced graphics software and hardware to increase the speed and flexibility of its EDA workstations.
- June 1984—The Company introduced its Fits & Tolerances Analysis software option for its Mechanical Design Application package.
- April 1984—Telesis signed a $10 million distribution agreement with Tokyo Keiki, Ltd., of Japan.
- April 1984—The Company's installed base reached 200 systems.
- November 1983—Telesis announced its integrated mechanical application software package.
- August 1983—The Company opened 10 new sales offices, bringing the total number of offices to 14.
- June 1983—Telesis announced automatic placement and routing software, a hardware graphics processor, and an 80-Mbyte disk drive upgrade.
- April 1983—Fiscal 1983 revenue of Telesis Systems Corporation reached $5.1 million.
- March 1983—Telesis closed third-round financing of $5 million, bringing in a total of $13.3 million financing; it also signed an agreement with Olivetti Tecnost for European product distribution.
- December 1982—The Company achieved its first $1 million revenue month.
- July 1982—Telesis made its first customer shipment and opened its northern and southern California sales offices.
- May 1982—The mid-Atlantic sales office opened.
- March 1982—Telesis installed its first customer beta test systems, made an official product announcement, and opened its New England office.
- January 1982—The Company closed the second round of financing for $6.3 million.
- January 1981—Telesis Systems Corporation began operations, completed product specifications, and closed its first round of financing for $1.5 million.
- 1980—The Company created a printed board design package.

CAD/CAM PRODUCTS

Telesis' product line consists of the Engineering Design Automation (EDA) series of software configured with hardware from Digital Equipment or IBM. The following is a description of the Company's major applications software products:

- EDA-1000 Design Capture System—The software has schematic capture functionality with a hierarchical data base. Major features include:
  - Hierarchical Editor—Contains up to 99 levels of hierarchy
  - Netlist Generation—Extracts pin and netlist data to be used with Telesis' EDA-3000 PCB product or host-based analysis and simulation products
  - Back-Annotation—Updates the schematic's pin number and reference designator assignment based on changes that may occur during layout
  - Bill of Material—Provides user-definable description and formats for listing parts used within a design
  - Symbol Library—Includes graphic representations with pinout and pin functions of approximately 1,200 schematic symbols
  - Relational Data Base—Available as an option
  - Networking—Ethernet from Interlan available as an option
- EDA-3000 Printed Circuit Design Applications Software—This product accommodates surface-mount designs, grid increments of 1 millimeter, and variable pad sizes. Major features include:
  - Automatic and interactive placement—Fully reentrant with user-definable control of component and area placement
  - Automatic and interactive gate swapping—Gates or pins automatically swapped, based on user-definable rules
  - Automatic and interactive routing—Fully reentrant; router works with three algorithms that can run on an entire board, on selected areas, on individual nets, or between individual pin pairs, providing on-line continuity checking; user-definable grid, line widths, and spacing
  - Netlist extraction and automatic gate assignment

- EDA-3200 ECL Toolbox—This set of software features is to be used in conjunction with the EDA-3000 application software to lay out emitter-coupled logic (ECL) and complimentary metal-oxide semiconductor (CMOS) designs. Major features include:
  - Performs automatic scheduling and terminator assignment for transmission line signal paths
  - Generates comprehensive reports for evaluation that includes information such as length and vias per signal net, lumped loading ration, and stub length
  - Integrates with the Telesis Thermal Analyzer
- EDA-4000 Mechanical Design Applications Software—This product supports a range of construction designs and drawings. Major features include:
  - Is in compliance with the International Standards Organization text fonts
  - Features T-square and Priority Find
    - T-square emulates a drafting machine by rotating into position once a reference geometry is specified.
    - Priority Find minimizes the number of input commands required by the system to recognize and execute geometric operations.

For system configurations and software, please refer to Table 2.

Table 2

Telesis Systems Corporation
CAD/CAM Systems

Name	Platform	Software	Application
EDA-10*	IBM PC	EDA-1000	EDA
EDA-20*	IBM PC XT	EDA-1000	EDA
EDA-30*	IBM PC XT	EDA-1000	EDA
EDA-620	SUN III	Routing	Routing, accelerator, thermal analysis
EDA-700	LSI 11/73	EDA-3000	PCB
		EDA-4000	Mechanical

*Monochrome series; also available as EDA-10C, -20C, -30C, with color graphics (EDA-1200 software)

Source: DATAQUEST
March 1986

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Telesis Systems Corporation

Telesis Systems Corporation
21 Alpha Road
Chelmsford, Massachusetts 01824
(617) 256-2300

Telesis Systems Corporation is a privately held company; therefore, balance sheet and income statement data are unavailable.

Telesis Systems Corporation

THE COMPANY

Background

Telesis Systems Corporation was founded in January 1981 in Chelmsford, Massachusetts. The Company was originally engaged in developing and marketing low-cost printed circuit board CAD/CAM systems. It has since expanded its applications scope to encompass front-end electronic design automation and mechanical CAD applications software.

Highlights

- February 1985--Telesis formally announced its entry into the electronic design automation CAD/CAM segment with its EDA-10, -20, and -30 systems products based on the IBM PC family.

- February 1985--The Company introduced the EDA-6000 coprocessor, a 32-bit plug-in option for its CAE workstations.

- September 1984--Telesis opened its West Germany and United Kingdom district sales offices.

- July 1984--The Company formed a $4.6 million research and development limited partnership with Kidder, Peabody & Co. Inc.

- July 1984--Telesis released enhanced graphics software and hardware to increase the speed and flexibility of its Engineering Design Automation workstations.

- June 1984--The Company introduced its Fits & Tolerances Analysis software option for its Mechanical Design Application package.

- April 1984--Telesis signed a $10 million distribution agreement with Tokyo Keiki, Ltd., of Japan for exclusive distribution of the Company's Engineering Design Automation workstations.

Telesis Systems Corporation

Organization, Marketing, and Sales

Telesis maintains its corporate headquarters at an 82,000-square-foot facility located in Chelmsford, Massachusetts. The Company has ten district offices worldwide at the following locations:

- Burlington, Massachusetts
- Fountain Valley, California
- Irving, Texas
- Iselin, New Jersey
- Phoenix, Arizona
- Santa Clara, California
- Schaumberg, Illinois
- Tampa, Florida
- Berkshire, United Kingdom
- Munich, West Germany

All of Telesis' district offices are full sales, demonstration, and customer support centers. The Company has a two-year agreement with Tokyo Keiki, Ltd., to distribute Telesis' EDA workstations in Japan. The two companies will jointly develop software and hardware modifications to incorporate the Japanese language and design standards into the Telesis system.

Telesis has 12 sales-only offices throughout the United States at the following locations:

- Bettendorf, Iowa
- Bluebell, Pennsylvania
- Dayton, Ohio
- Denver, Colorado
- Lilburn, Georgia
- McLean, Virginia
- Minneapolis, Minnesota
- Pineville, North Carolina
- Redmond, Washington
- Rochester, New York
- Salt Lake City, Utah
- Southford, Michigan

During 1984, the number of Telesis employees increased to 290, a growth of 62 percent over the 185 employees in 1983. Please refer to Table 1 for details of employee distribution by department.

Table 1

EMPLOYEES BY DEPARTMENT

Research and Development	81
Marketing and Sales	155
Manufacturing	21
Administration	33
Total	290

Source: Telesis Systems Corporation

Research and Development

Telesis' Research and Development Department is located at its headquarters in Chelmsford. Approximately 80 percent of the 81 people involved in the Company's R&D are dedicated to applications software development. Another 10 percent are involved in the development of workstations, and the remaining 10 percent interface with both hardware and software development engineers.

The Company will continue to develop a wide range of applications products, including mechanical applications software, logic simulation, timing analysis, thermal analysis, and enhancements to existing products.

Manufacturing

Approximately 7 percent of the Company's employees, or 21 people, are involved in the manufacturing of its products. Telesis maintains its manufacturing facilities at its headquarters in Chelmsford, Massachusetts. The Company's primary manufacturing activities involve assembling, integration, and test of major system components.

Support

After the sale of a system, an Applications Support Coordinator works with the customer through the installation and training of the staff who will be using the system.

Credits for training courses are included in the system purchase price. There are three basic courses available to customers:

- PCB design (five days)
- Mechanical design (five days)
- Managers' seminars (three days)

There is no training course available for the Company's EDA products; Telesis views the EDA-1000 as self-tutorial. However, the Company will send an Applications Engineer to the customer site on the date of installation to work with the intended operator on the system. Also, there is a manual available with the system.

Customer support includes a 90-day warranty from the date of installation on the system(s) purchased. This may then be followed by an ongoing, annually renewable maintenance agreement that includes free software upgrades and a modem connection via an 800 number to Telesis' corporate support department. The modem connection allows the customer to call the Company and then enables the applications engineer to pinpoint the problem by looking at the system via the modem, thus shortening the problem-solving cycle.

Maintenance on all systems is provided by the Company. When the customer has purchased hardware (the IBM PC or Digital Equipment Corporation LSI products) through another source, Telesis offers the option of transferring maintenance services to the Company or continuing to have the hardware serviced by the original source.

MAJOR HISTORICAL MILESTONES

Below is a reverse-chronological list of the events that have shaped Telesis' history as a CAD/CAM company, up to its most recent fiscal year beginning May 1.

- April 1984--Installed base reached 200 systems
- November 1983--Integrated mechanical application software package announced
- August 1983--Ten new sales offices opened, bringing the total offices to 14
- June 1983--Automatic placement and routing software, hardware graphics processor, and an 80-Mbyte disk drive upgrade announced

- April 1983--Fiscal 1983 revenue reached $5.1 million
- March 1983--Closed third-round financing of $5 million, bringing in a total of $13.5 million financing; signed an agreement with Olivetti Tecnost for European product distribution
- December 1982--Achieved the first $1 million revenue month
- July 1982--First customer shipment; northern and southern California sales offices opened
- May 1982-- Mid-Atlantic sales office opened
- March 1982--First customer beta test systems installed; official product announcement made; New England office opened
- January 1982--Closed second round of financing for $6.3 million
- January 1981--Began operations; completed product specifications; closed first round of financing for $1.5 million
- 1980--Created printed circuit board design package

CAD/CAM PRODUCTS

Telesis' product line consists of the Engineering Design Automation (EDA) series of software configured with hardware from Digital Equipment or IBM. Each of the Company's major applications software products is described below.

- EDA-1000--Schematic capture functionality with a hierarchical data base. Major features include:
  - Hierarchical Editor--Contains up to 99 levels of hierarchy
  - Netlist Generation--Extracts pin and netlist data to be used with Telesis' EDA-3000 PCB product or host-based analysis and simulation products
  - Back-Annotation--Updates the schematic's pin number and reference designator assignments based on changes that may occur during layout

- Bill of Material--Provides user-definable description and formats for listing parts used within a design

- Symbol Library--Includes graphic representations with pinout and pin functions of approximately 1,200 schematic symbols

- Relational Data Base--Is available as an option

- Networking--Ethernet from Interlan is available as an option

● EDA-3000--Printed circuit design application software that can accommodate surface-mount designs, 1-millimeter grid increments, and variable pad sizes. Major features include:

- Automatic and interactive placement--Fully reentrant with user-definable control of component and area placement

- Automatic and interactive gate swapping--Gates or pins can be automatically swapped, based on user-definable rules

- Automatic and interactive routing--Fully reentrant, the router works with three algorithms that can run on an entire board, on selected areas, on individual nets, or between individual pin pairs, providing on-line continuity checking. Grid, line widths, and spacing are user definable

- Netlist extraction and automatic gate assignment

● EDA-4000 mechanical design application software--Supports a range of construction and drawing annotation features for the generation of two-dimensional graphics for engineering layouts, detail, and assembly drawings

- Compliance with the International Standards Organization text fonts

- Features T-square and Priority Find (T-square emulates a drafting machine by rotating into position once a reference geometry is specified. Priority Find minimizes the number of input commands required by the system to recognize and execute geometric operations.)

For system configurations and software, please refer to Table 2.

Table 2

TELESIS' CAD/CAM SYSTEMS

Name	Processor	Software	Application
EDA-10	IBM PC	EDA-1000	EDA
EDA-20	IBM PC XT	EDA-1000	EDA
EDA-30	IBM PC AT	EDA-1000	EDA
EDA-100	LSI 11/73	EDA-4000	Mechanical
EDA-150	LSI 11/23	EDA-4000	Mechanical
EDA-300	LSI 11/73	EDA-3000	PCB

Source: DATAQUEST

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Tektronix, Inc.

Tektronix, Inc.
4900 S.W. Griffith Drive
Beaverton, Oregon 97077
Telephone: (503) 627-7111 Telex: 151754
(Millions of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF APRIL 1

BALANCE SHEET DATA	1981	1982	1983	1984	1985	CAGR 1981-1985
Working Capital	$ 359.2	$ 390.2	$ 445.6	$ 532.0	$ 537.4	10.3%
Long-Term Debt	$ 146.1	$ 132.2	$ 152.7	$ 170.5	$ 90.1	3.9%
Shareholders' Equity	$ 557.5	$ 632.1	$ 665.7	$ 783.2	$ 855.0	8.9%
After-Tax Return on Average Equity (%)	15.4%	13.3%	7.2%	15.5%	11.0%	0.1%
OPERATING PERFORMANCE						
Revenue	$1,061.8	$1,195.8	$1,191.5	$1,332.9	$1,438.1	5.8%
U.S. Revenue	$ 625.3	$ 729.4	$ 734.3	$ 862.9	$ 923.7	8.4%
Non-U.S. Revenue	$ 436.5	$ 466.4	$ 457.2	$ 470.0	$ 514.4	1.9%
Cost of Goods Sold	$ 513.1	$ 595.3	$ 616.0	$ 672.9	$ 693.4	7.0%
Gross Margin	$ 548.7	$ 600.5	$ 575.5	$ 660.0	$ 744.6	4.7%
Expenses	$ 349.0	$ 398.8	$ 433.7	$ 483.9	$ 558.0	8.5%
R&D Expense	$ 91.1	$ 109.2	$ 126.6	$ 151.8	$ 191.2	13.6%
SG&A Expense	$ 257.8	$ 289.6	$ 307.2	$ 332.1	$ 366.9	6.5%
Other Expense						
Operating Income	$ 199.7	$ 201.7	$ 141.8	$ 176.1	$ 186.6	(3.1%)
Interest Expense	$ 25.3	$ 29.5	$ 25.8	$ 25.5	$ 19.3	0.2%
Interest Income	$ 19.6	$ 9.5	($ 25.5)	$ 0.9	$ 12.2	(53.1%)
Other Income (Expense)						
Income before Tax	$ 138.1	$ 126.2	$ 61.2	$ 106.0	$ 120.5	(6.4%)
Note: Pretax Margin	13.0%	10.6%	5.1%	8.0%	8.4%	(11.6%)
Taxes	$ 52.2	$ 47.0	$ 14.4	($ 6.1)	$ 30.3	N/M
Note: Effective Tax Rate	37.8%	37.2%	23.5%	(5.7%)	25.1%	
Net Income after Tax	$ 80.2	$ 79.3	$ 46.8	$ 112.1	$ 90.2	8.7%
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	18.5	18.7	19.1	19.5	20.5	1.3%
Per Share						
Earnings	$ 4.34	$ 4.23	$ 2.45	$ 5.74	$ 4.40	7.2%
Dividends	$ 0.90	$ 0.98	$ 1.00	$ 1.00	$ 1.00	2.7%
Book Value	$ 30.16	$ 33.82	$ 34.85	$ 40.16	$ 41.70	7.4%
Price Range (Low)	$ 47 1/2-	$ 42 3/8-	$ 34-	$ 55-	$ 51 1/8-	
(High)	70 1/4	61 1/2	76 1/2	86 3/4	68 1/4	
TOTAL EMPLOYEES	24,028	23,231	21,078	20,693	20,525	(3.7%)
Revenue per Employee	$ 0.00	$ 0.10	$ 0.10	$ 0.10	$ 0.01	9.9%

N/M = Not Meaningful

Source: Tektronix, Inc., Annual Reports and Forms 10-K
DATAQUEST

Tektronix, Inc.

Tektronix, Inc.
4900 S.W. Griffith Drive
Beaverton, Oregon 97077
Telephone: (503) 627-7111 Telex: 151754
(Millions of Dollars Except Per Share Data)

LINE ITEMS AS A PERCENT OF REVENUE

	1981	1982	1983	1984	1985
OPERATING PERFORMANCE					
Revenue	100.0%	100.0%	100.0%	100.0%	100.0%
U.S. Revenue	58.9%	61.0%	61.6%	64.7%	64.0%
Non-U.S. Revenue	41.1%	39.0%	38.4%	35.3%	36.0%
Cost of Goods Sold	$ 0.5	$ 0.5	$ 0.5	$ 0.5	$ 0.5
Gross Margin	51.7%	50.2%	48.3%	49.5%	51.8%
Expenses	33.0%	33.3%	36.4%	36.3%	38.8%
R&D Expense	8.6%	9.1%	10.6%	11.4%	13.3%
SG&A Expense	24.4%	24.2%	25.8%	24.9%	25.5%
Operating Income	18.8%	16.9%	11.9%	13.2%	13.0%
Interest Expense	2.4%	2.5%	2.2%	1.9%	1.3%
Interest Income	1.8%	0.8%	(2.1%)	0.1%	0.8%
Income before Tax	13.0%	10.6%	5.1%	8.0%	8.4%
Taxes	4.9%	3.9%	1.2%	(0.5%)	2.1%
Net Income after Tax	7.6%	6.6%	3.9%	8.4%	6.3%

Source: Tektronix, Inc., Annual Reports
and Forms 10-K
DATAQUEST

Tektronix, Inc.

THE COMPANY

Background

Tektronix, Inc., was founded in Oregon in 1946. The Company develops, manufactures, markets, and services a wide range of products including test instruments, design automation equipment, graphics display terminals, desktop computers, and communications devices. The focus of this corporate profile will be the Company's involvement in the CAD/CAM industry.

Highlights

Listed below in reverse chronological order are the major events that have highlighted Tektronix' most recent fiscal year:

- July 1985--Tektronix introduced the 4405 and 4406 Artificial Intelligence Systems.

- June 1985--Tektronix' entrance into the electronic CAD/CAM (CAE) industry was marked by numerous new product announcements; including the following:

  - Availability of Seattle Silicon's silicon compiler on CAE 2000-based workstations

  - Introduction of the MultiSim family of simulation products to create, compare, and analyze data

  - Announcement of DASLink, a software module that integrates the capabilities of MultiSim and the Tektronix DAS 9100

  - Introduction of TekWriter technical publications software to be used with CAE 2000 software

  - Addition of LEIA, a custom integrated circuit (IC) layout editor for use with CAE 2000-based workstations

  - Introduction of the TekStation AT, based on the IBM Personal Computer AT

  - Availability of ECAD's Dracula II layout verification package on CAE 2000-based workstations

- May 1985--Tektronix announced CONNECTIONS, a cooperative marketing program for IC vendors' libraries.

Tektronix, Inc.

- May 1985--The Company introduced PLOT 10 GKS SoftStation for developing device-independent graphics programs.

- April 1985--Tektronix announced the realignment of its Information Display Group in Wilsonville, Oregon.

- April 1985--The Company completed the acquisition of CAE Systems, an electronic CAD/CAM company based in Sunnyvale, California.

- January 1985--Tektronix announced the 4120 Series of color graphic workstations with varying degrees of two- and three-dimensional performance.

Organization

Tektronix maintains its corporate headquarters at a 365-acre facility in Beaverton, Oregon. Research and development, engineering and assembly of test and measurement products, manufacturing, systems integration, and administrative functions are located at this facility and in leased buildings nearby. Please refer to Table 1 for further information on other major operations sites.

The company has several subsidiaries domestically, including the Grass Valley Group, Incorporated, of Grass Valley, California; Dubner Computer Systems, Incorporated, of Fort Lee, New Jersey; and CAE Systems, Incorporated, of Sunnyvale, California. Tektronix recently merged another subsidiary, VR Information Systems, Incorporated, of Austin, Texas, with CAE Systems to form the CAE Systems Division.

Tektronix employs 20,525 people worldwide, including 16,448 people in the United States.

Tektronix, Inc.

Table 1

Tektronix, Inc.
MAJOR OPERATIONS SITES

Location	Size
Clark County, Washington	270 acres
Fairview, Connecticut	136 acres
Forest Grove, Oregon	100 acres
Lebanon, Ohio	252 acres
Redmond, Oregon	100 acres
Washington County, Washington	46 acres
Wilsonville, Oregon	250 acres

Source: DATAQUEST

Research and Development

Product development is done at the Company's Sunnyvale and United Kingdom facilities as well as at corporate headquarters. The Company has redirected its product development efforts within its workstation division group to encompass the utilization of industry-standard hardware platforms such as Digital Equipment Corporation and IBM. UTek, Tektronix's version of the UNIX Operating System, will be the unifying basis for further workstation development strategies.

Research and development expenses were 13.3 percent of revenue in 1985, compared with 11.2 percent in 1984.

Manufacturing

The cost of sales for fiscal 1985 was 48 percent of revenue, compared to 50 percent in 1984. The Company maintains five domestic manufacturing facilities in Oregon and one in Washington, as well as six international manufacturing facilities in the following areas:

- The Channel Islands
- Japan
- The Netherlands
- The United Kingdom

System integration is done at Company headquarters in Oregon and at facilities in Sunnyvale, California, and Boston, Massachusetts.

Marketing and Sales

Marketing and sales expenses were 25 percent of revenues for fiscal 1985, compared to 15 percent in 1984. The Company has 44 sales and service offices in the following areas of the United States:

- Alabama
- Arizona
- California
- Colorado
- Connecticut
- District of Columbia
- Florida
- Georgia
- Illinois
- Kansas
- Louisiana
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Missouri
- New Jersey
- New York
- North Carolina
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- Texas
- Utah
- Washington

U.S.-based sales represented approximately 64 percent of revenue in 1985, compared with 62 percent in 1984; international sales represented 27 percent of revenues in 1985, compared with 38 percent of revenues in 1984. Tektronix has 19 foreign operating subsidiaries. Please refer to Table 2 for the names and locations of these facilities.

Table 2

Tektronix, Inc.
TEKTRONIX FOREIGN SUBSIDIARIES

Country	Company
Australia	Tektronix Australia Party, Ltd.
Austria	Tektronix Ges.m.g.H.
Belgium	Tektronix, S.A.
Brazil	Tektronix Industria e Comercio, Ltda.
Canada	Tektronix Canada Incorporated
Denmark	Tektronix A/S
Finland	Tektronix Oy
France	Tektronix
Germany	Tektronix GmbH
Ireland	Tektronix U.K., Limited
Italy	Tektronix S.p.A.
Japan	Sony/Tektronix Corporation*
Mexico	Tektronix S.A. de C.V.*
Netherlands	Tektronix Holland
Norway	Tektronix Norge A/S
Spain	Tektronix Espanola S.A.
Sweden	Tektronix AB
Switzerland	Tektronix International A.G.
United Kingdom	Tektronix, U.K. Limited

*Joint venture company

Source: DATAQUEST

Support

Tektronix has domestic customer support and service centers in Beaverton, Boston, and Sunnyvale and international centers in the Netherlands and the Channel Islands. The Boston facility is the support center for all Digital Equipment Corporation products, and the Sunnyvale facility is the support center for applications software. The Netherlands office is the main support center for Tektronix's international operations.

Tektronix, Inc.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are major events that have shaped Tektronix's history in the CAD/CAM industry:

- 1983--Logic Design Systems was formed as a business unit of Design Automation Division.
- 1981--Tektronix GmbH, Germany, was formed.
- 1981--Tektronix had its first billion-dollar sales year.
- 1980--Tektronix S.A. de C.V., Mexico, was formed as a joint venture.
- 1979--Tektronix S.p.A., Italy, was established.
- 1978--Servicios Technicos, Brazil, opened for sales and service.
- 1978--The Scandinavian Operations Center was established in Amstelveen, Norway.
- 1978--Tektronix, Oy, Finland, was founded.
- 1978--Tektronix Norge A/S, Norway, was established.
- 1978--European Marketing Center, Amstelveen, Norway, was formed.
- 1978--Tektronix, Espanola, was established in Spain.
- 1974--The Grass Valley Group, Incorporated, was acquired; the Logic Analyzer business unit was created.
- 1973--The Company decided to pay dividends.
- 1973--Tektronix's Industria e Comercio Ltda., Brazil, was formed.
- 1972--Rhode and Schwarz Tektronix GmbH joint venture was established in Austria for Austrian and East European sales.
- 1969--Tektronix A/S Incorporated was founded in Denmark.
- 1967--The Company decided to produce computer terminals.
- 1965--Sony/Tektronix was established.
- 1963--The first public offering of Tektronix shares (540,000 shares) took place.
- 1959--The Guernsey Island operation commenced manufacturing.

Tektronix, Inc.

- 1953--Tektronix patented its own circuit design.
- 1946--Tektronix was incorporated.

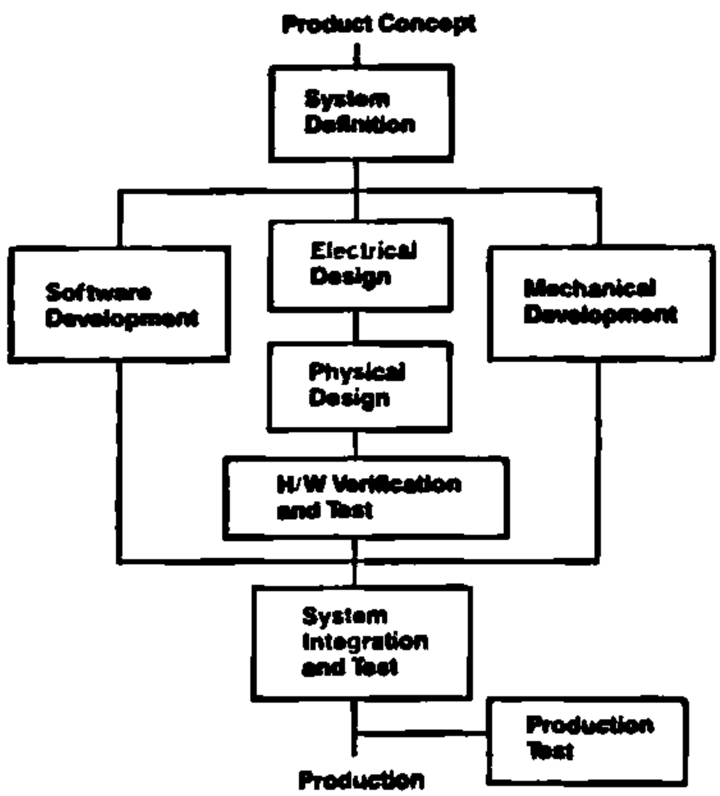
CAD/CAM BUSINESS AND PRODUCTS

Tektronix bases its CAD/CAM product offerings on the Apollo Domain Series, the Digital Equipment VAX computers, and the IBM personal computers, as well as on proprietary hardware.

The Company bases its software offerings on two packages: DDSC and MultiSim. DDSC is the Designer's Data Base and Schematic Capture, and MultiSim consists of integrated design simulation modules. See Figure 1.

Figure 1

ELECTRONIC PRODUCT DESIGN



Source: Tektronix

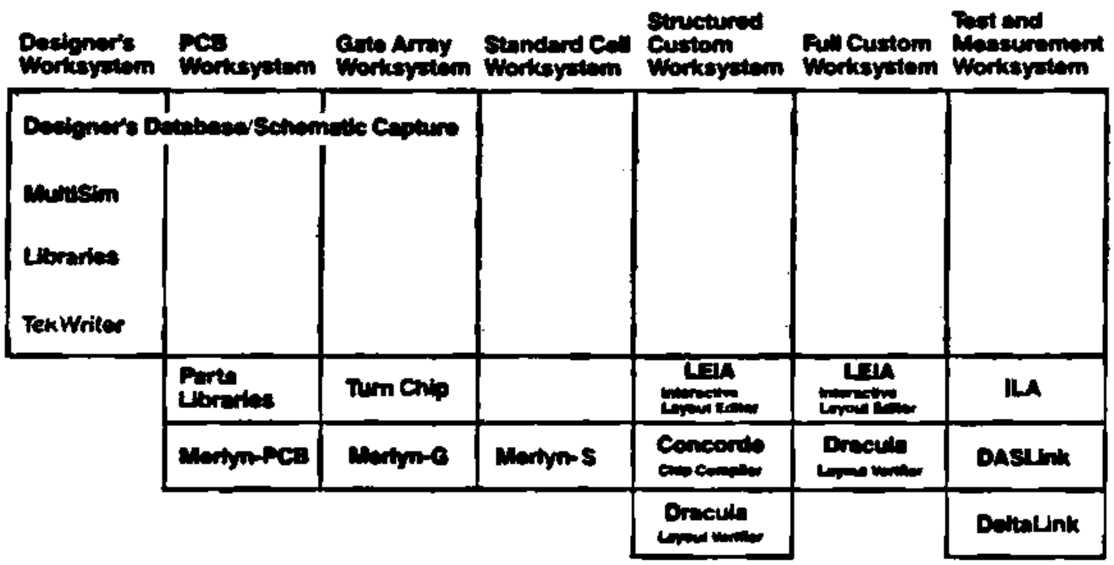
Tektronix, Inc.

Tektronix's application software products range from the design of integrated circuits to test and measurement tools. Additionally, the Company offers interfaces to other popular electronic CAD/CAM software for the simulation and design of printed circuit boards and integrated circuits. In structuring its CAD/CAM product offerings, the Company views the design cycle as illustrated in Figure 2.

For further information on Tektronix's CAD/CAM products, please refer to Table 3.

Figure 2

APPLICATION SOFTWARE CONFIGURATION



Source: Tektronix

Table 3

Tektronix, Inc.
CAD/CAM PRODUCTS

SYSTEMS

Name	Manufacturer	Maximum Number of Workstations
VAX 11/750	Digital Equipment	6
VAX 11/780	Digital Equipment	12
VAX 11/8600	Digital Equipment	36

WORKSTATION

Name	Manufacturer	Resolution	Number of Colors
DN 300	Apollo Computer	1,024 x 800	1
DN 320	Apollo Computer	1,024 x 800	1
DN 460	Apollo Computer	1,024 x 800	1
DN 550	Apollo Computer	1,024 x 800	256
DN 660	Apollo Computer	1,024 x 1,024	256
TekStation AT	IBM	720 x 704	1*
Tektronix 6130	Proprietary	640 x 480	8

APPLICATIONS SOFTWARE

Name	Application
Libraries	Behavioral and graphic models for ICs
Librarian System	Modification and development of libraries
Merlyn-G	Gate arrays, automatic placement and routing
Merlyn-S	Standard cell IC layout
LEIA	Layout editor for manually created IC geometries
Dracula II	Layout verification for manually edited ICs

(Continued)

Table 3 (Continued)

Tektronix, Inc.
CAD/CAM PRODUCTS

APPLICATIONS SOFTWARE (Continued)

Name	Application
Designer's Calculator	Calculates circuit design parameters
HiLo-3	Logic simulation
Concorde Compiler	Silicon compiler
Merlyn PCB	Automated PCB Design System
DASLink	Interface to the Tektronix DAS9100 Logic Analyzer
MicroLink	Interface to software development tools
TekWriter	Publications software based on Interleaf Workstation Publications software
SPICE	IC circuit simulation (MultiSim Module)
Testability Measurement Analyzer	Measures circuit testability on early stages of design (MultiSim Module)
Statistical Fault Analyzers	Analyzes quality of input test patterns (MultiSim module)
TurboChip	Hardware "C" modeling (MultiSim Module)
IDEAL	Interactive, multilevel simulation
Behavioral Modeling Language	Creation of behavioral models (MultiSim Module)

(Continued)

Table 3 (Continued)

Tektronix, Inc.
CAD/CAM PRODUCTS

INTERFACES

Name	Company	Application
The Logic Evaluator	ZYCAD	Logic simulation
Calay	Calay Systems	V03 PCB routing engine
CADDS 4	Computervision	PCB, mechanical, AEC, and mapping system
REDBOARD	Racal-Redac	IBM PC-based PCB layout; automatic place and route
SCICARDS	Scientific Calculations	Automatic PCB
MEDS	Scientific Calculations	Automatic IC design
CAL-MP	Silvar-Lisco	Standard cell layout system; automatic place and route
GARDS	Silvar-Lisco	Gate array layout; automatic place and route; interactive routing editing

*Color option available

Source: DATAQUEST

Tektronix, Inc.

Tektronix, Inc.
4900 S.W. Griffith Drive
Beaverton, Oregon 97077
Telephone: (503) 627-7111 Telex: 151754
(Millions of Dollars Except Per Share Data)

Balance Sheet (Fiscal Year Ending May 29)

	1979	1980	1981	1982	1983
Working Capital	$275.6	$347.1	$ 359.2	$ 388.7	$ 442.3
Long-Term Debt	$ 62.1	$136.2	$ 146.1	$ 132.1	$ 152.3
Shareholders' Equity	$402.8	$483.3	$ 557.5	$ 630.4	$ 661.7
After-Tax Return on Average Equity (%)	21.2	19.2	15.4	13.4	7.5

Operating Performance (Fiscal Year Ending May 29)

	1979	1980	1981	1982	1983
Revenue	$786.9	$971.3	$1,061.8	$1,195.7	$1,191.4
U.S. Revenue	$487.2	$591.8	$ 625.3	$ 729.3	$ 734.2
Non-U.S. Revenue	$299.7	$379.5	$ 436.5	$ 466.4	$ 457.2
Cost of Revenue	$359.7	$458.5	$ 513.1	$ 595.3	$ 615.9
R&D Expense	$ 60.6	$ 77.8	$ 91.1	$ 109.1	$ 125.4
SG&A Expense	$181.5	$223.7	$ 257.8	$ 289.6	$ 306.3
Pretax Income	$126.6	$136.9	$ 132.4	$ 126.4	$ 63.1
Pretax Margin (%)	16.1	14.1	12.5	10.6	5.3
Effective Tax Rate (%)	39.0	37.8	39.4	37.1	22.8
Net Income	$ 77.1	$ 85.1	$ 80.1	$ 79.4	48.7
Average Shares Outstanding (Millions)	18.1	18.4	18.6	18.7	18.9
Per Share					
Earnings	$ 4.28	$ 4.66	$ 4.34	$ 4.25	$ 2.57
Dividends	$ 0.60	$ 0.79	$ 0.90	$ 0.98	$ 1.00
Book Value	$22.25	$26.26	$ 29.97	$ 33.53	$ 35.01
Price Range	$39-57	$41.63-64.25	$ 47.50-70.25	$ 42.38-61.50	$ 34.00-76.50
Total Employees	21,291	23,890	24,028	23,231	21,078

Source: Tektronix, Inc., Annual Reports and Forms 10-K

Tektronix, Inc.

BACKGROUND

The Company

Tektronix, Inc., was founded in Oregon in 1946. The Company develops, manufactures, markets, and services a wide range of products including test instruments, design automation equipment, graphics display terminals, desktop computers, and communications devices. Its customers include electronic equipment and computer manufacturers, government agencies, educational institutions, and the broadcast television industry. Tektronix is a highly vertically integrated manufacturer, designing and producing most of the components for its products.

1983 Highlights

In April 1983, the Company introduced the 4100 family of low-cost color raster display terminals. Presently, the family includes the 4105, the 4107, and the 4109. The terminals are compatible with the Company's 4010 series and upwardly compatible with the 411X series. In addition, the 4100 family supports PLOT 10 software. The Company also announced the 4170 Local Graphics Processing unit, a programmable processor for converting the 4105, 4107, or 4109 terminals to standalone computers with the capability to manipulate and store display files.

At the same time, the Company introduced the 4115B color raster graphics display terminal, marking Tektronix's entry into the high end of the raster graphics terminal marketplace.

In June 1983, the Company announced the acquisition of VR Information Systems, a developer of software for electronic layout design of standard cells and gate arrays.

In November, the Company announced the formation of a venture capital subsidiary, Tektronix Development Company. The purpose of this company is to sponsor or invest in technologies developed within Tektronix that are outside the interest areas of existing Tektronix divisions.

The year 1983 was one of revival for Tektronix as the Company strived to regain its lead in the graphics market with both low- and high-end raster graphics product introductions. The Company has been forced to adopt a new strategy for the CAD/CAM marketplace to compete with new technologies and good competitive products from other companies. DATAQUEST believes that Tektronix's new products and their compatibility with the Company's large installed base provide Tektronix with the necessary tools to reestablish a strong position in the CAD/CAM graphics marketplace.

Tektronix, Inc.

Operations

Tektronix's 1983 revenues of $1,191.4 million reflect a decrease of approximately 4 percent below 1982 revenues of $1,195.7 million.

There are three reporting groups within Tektronix, each responsible for one or more of the Company's five product divisions. Table 1 lists sales for each of these operating groups for the past five years. The Instruments Products Group, consistently the Company's largest in terms of revenue, accounted for 44.2 percent of 1983 sales. The Design Automation and Information Display Products Group accounted for 38.2 percent of revenues for this period. Table 2 presents operating group sales as a percentage of total sales.

Table 1

Tektronix, Inc.
REVENUE BY OPERATING GROUP
(Millions of Dollars)

	1979	1980	1981	1982	1983
Instrument Products	$435.1	$504.4	$ 507.6	$ 567.9	$ 526.7
Design Automation and Information Display Products	242.7	327.1	391.1	441.5	455.3
Communication Products	109.1	139.8	163.1	186.3	209.4
Total	$786.9	$971.3	$1,061.7	$1,195.7	$1,191.4

Source: Tektronix, Inc., Form 10-K

Table 2

Tektronix, Inc.
REVENUE BY OPERATING GROUP
(Percent of Total Sales)

	1979	1980	1981	1982	1983
Instrument Products	55.3%	51.9%	47.8%	47.5%	44.2%
Design Automation and Information Display Products	30.9	33.7	36.8	36.9	38.2
Communication Products	13.8	14.4	15.4	15.6	17.6
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Tektronix, Inc., Form 10-K

Tektronix Industrial Park is the site of the Company's administrative offices, central research and development, and a substantial portion of its product manufacturing and warehousing. This facility, a Company-owned 287-acre site located in Beaverton, Oregon, includes 25 buildings and approximately 3 million square feet of enclosed floor space.

The Jack Murdock Park, located in Vancouver, Washington, is a 489,000-square-foot facility dedicated to the Company's founder. This facility houses the Tektronix portable oscilloscope manufacturing operations. The Design Automation Division occupies approximately 415,000 square feet of manufacturing and office space in three buildings near Aloha, Oregon.

Tektronix also has a new etched circuit board manufacturing facility on its 100-acre site near Forest Grove, Oregon. In addition, the Company owns an estimated 560 acres of undeveloped land in Oregon that is available for future expansion.

Tektronix, Inc.

International Operations

Tektronix's non-U.S. revenues of $457.2 million in 1983 reflect a decrease of approximately 2.0 percent below 1982 revenues of $466.4 million. The Company maintains European headquarters in Amstelveen, the Netherlands, and provides marketing, support services, and customer training from this location for Europe, Africa, and the Middle East.

Tektronix owns and operates manufacturing facilities in the Channel Islands, England, and in the Netherlands, totaling an estimated 272,000 square feet. Company-owned field sales offices are located in Montreal, Canada; Paris, France; London, England; Ontario, Canada; and Sydney, Australia.

Company Structure and Employees

Tektronix is organized into three operating groups, each having product line as well as specific operational responsibilities.

The Instruments and Technology Group includes the Instrument Division (the Company's largest) and the Technology Group. The Instrument Division's products include oscilloscopes, scope accessories, and waveform-recording cameras. The Technology Group produces high-technology components, including storage and cathode-ray tubes, integrated circuitry, and hybrid circuitry, and also includes the Company's R&D organization.

The Design Automation and Information Display Products Group combines the Design Automation Division and the Information Display Division. The Design Automation Division's products include logic analyzer systems, microprocessor development systems, and large semiconductor test systems. The Information Display Division produces color and monochrome computer graphics terminals, graphics computing systems, display monitors, hard copy units, and plotters. The group also produces a wide range of electrical and mechanical components and is responsible for the Company's Manufacturing Resource Planning Program.

The Communications and International Group includes the Communications Division, International Operations, Corporate Marketing and Service, and Distribution and Procurements. The Communications Division produces spectrum analyzers, cable testers, and television instruments. The Company's California subsidiary, the Grass Valley Group, Inc., is included in this group and produces production and routing switches, and special-effects systems for television.

Tektronix, Inc.

As of May 1983, Tektronix employed 21,078 employees, 3,108 of whom were located in foreign countries.

Marketing

Tektronix maintains its own worldwide sales and field maintenance organization with 110 field offices located in principal market areas. Sales in Japan are handled by Sony/Tektronix Corporation. Sales in Mexico are made by Tektronix S.A. de C.V., a Mexican company that is 49 percent owned by Tektronix. The Company maintains distributor relationships with 51 companies representing Tektronix in 48 foreign countries. In other countries, sales are made directly by Tektronix or by independent representatives to whom Tektronix provides direct technical and administrative assistance.

In May 1982, the Information Display Division announced its Solution Vendor Program. This program provides Tektronix users with information on application-specific software that is compatible with Tektronix products and that is developed by selected third-party software vendors. The program is intended to assist users in installing timely, cost-effective solutions to software problems, and focuses on engineering and scientific applications. Currently, there are approximately 35 registered third-party software vendors in the Solution Vendor Program.

Research and Development

Tektronix invested $125.4 million in research and development in 1983, up 13 percent from $109.1 million in 1982. The Company expects current levels of R&D expenditures to continue in 1984. Ongoing activities include research on basic devices and techniques, and design and development of products, components, and specialized equipment and processes needed for production.

PRODUCTS--INFORMATION DISPLAY DIVISION

Display Terminals

The 4100 family of color computer display terminals, designed to address applications including data analysis, presentation graphics, computer-aided design, computer programming, and text editing, was introduced in April 1983. The family consists of the 4105, the 4107, and the 4109 computer display terminals.

The 4105 and 4107 have 13-inch color displays. The 4109 has a 19-inch display. All three terminals feature a 60-Hz noninterlaced raster refresh rate and can display 8 colors from a palette of 64. The 4105 has 480 x 360 resolution. The 4107 and 4109 have 640 x 480 resolution. The 4100 family is compatible with the Company's 4010 terminals and is upwardly compatible with the Company's 4110 series, as well as with existing PLOT 10 software. Prices for the 4105, 4107, and 4109 are $3,995, $6,950, and $9,950, respectively.

The 4110 series of computer display terminals is a family of products consisting of the 4112, 4113, 4114 terminals and the new 4115B terminal, announced in 1983. The series is compatible with the Company's 4010 terminals, as well as with the existing PLOT 10 software library.

The 4112 display terminal utilizes raster technology and provides a 15-inch display with 640 x 480 resolution and 4,096 x 4,096 addressable points. Features of the 4112 include local picture segments, 2-D transforms, pan and zoom capability, and a multiviewport feature that allows for definition of 16 different logical display areas at one time.

The 4113 display terminal provides color raster capability with 640 x 512 resolution, 32 Kbytes of RAM, and 88 Kbytes of ROM. Three bit planes are standard on the 4113, which can display 8 colors at one time from a palette of 4,096 available colors. Features of the 4113 include local picture segments, retained in the terminal's memory; rotation, scaling, and transforming of local segments; pan and zoom capability; and a user-definable scrolling dialog area.

The 4114 is based on the Company's 19-inch storage tube. Features of the 4114 include 1 Mbyte of total RAM and ROM local memory, with optional single or dual flexible disk mass storage of 512 Kbytes per disk; a definable, scrollable dialog area, functionally equivalent to a separate alphanumeric display; and user-defined graphic segments and two-dimensional transforms. Available options include color-enhanced refresh and block-mode data transfer.

The 4115B is a 19-inch color raster display terminal with 1,280 x 1,024 resolution, 60-Hz noninterlaced refresh rate, and 16 colors standard from a palette of 4,096 available colors. Features of the 4115B include local picture segment, true zoom and pan, and autoconvergence. In addition, the system runs with local user-programmable microprocessors and disks.

Typical prices for the 4110 series range from $5,500 to $23,000.

Software

PLOT 10

The PLOT 10 Graphics Software Library includes tools that enable users to create fundamental graphics functions and special-purpose graphics routines. PLOT 10 is host-CPU independent and runs on the Company's 4010 and 4110 series computer display terminals. PLOT 10 TekniCAD runs on the Company's 410X and 411XB graphics terminals.

PLOT 10 includes the following software libraries:

- The Terminal Control System provides a composite of FORTRAN IV subroutines linked through a set of common variables, providing building blocks for graphics operators of varying sophistication levels.

- The Interactive Graphics Library (IGL) is designed according to the ANSI/SIGGRAPH proposed standard. IGL provides windowing, rotation, scaling, and text manipulation capabilities, with extensions for smoothing and contouring. The 3-D graphics support option provides perspective projections, 3-D scaling, rotation, translation, and interactive digitizing.

- Easy Graphing enables the user to generate presentation-quality visuals via simple commands for graph creation. A color version enables the user to implement complex colored graphs on the Company's interactive digital plotters for camera-ready color plots, slides, or transparencies.

- Computer-Aided Drafting (TekniCAD) enables the operator to create detailed engineering drawings by accessing the terminal's hardware graphics features.

PLOT 50

PLOT 50 is a set of high-level utility packages designed to run on Tektronix's 4050 series of desktop computers. Most PLOT 50 packages are menu-driven and provide built-in tutorials.

PLOT 50 includes the following software libraries:

- The 2-D Drafting package, which complies with the ANSI Y14 and ISO standards, contains flexible routines for creating geometry, annotation, dimensioning, and symbol manipulation.

- The Interactive Digitizing package enables users to create and edit files for analysis and processing.
- The Document Preparation software accomplishes text formatting for creating and editing technical documents.

Desktop Computers

Tektronix offers three direct view storage tube (DVST) type graphics desktop computers in its 4050 series. The 4051 has an 8-bit processor with graphics resolution of 1,024 x 780. The 4052A has a 16-bit processor with graphics resolution of 1,024 x 780 viewable points and 1,024 x 1,024 addressable points. The 4054A has a 19-inch display with 4,096 x 3,120 resolution and 4,096 x 4,096 addressable points. All 4050 series desktop computers support the BASIC programming language at different levels of sophistication. Pricing on the 4051, 4052A, and 4054A starts at $4,995, $9,900, and $12,950, respectively.

Valid Logic Systems
Incorporated

Valid Logic Systems Incorporated

Valid Logic Systems Incorporated
2820 Orchard Park Way
San Jose, California 95134
Telephone: (408) 945-9400 Telex: 371-9004
(Millions of Dollars Except Per Share Data)

Balance Sheet (December 31)

	1981	1982	1983	1984	1985	CAGR 1981-1985
Working Capital	$1.8	$6.0	$ 37.5	$ 36.2	$ 37.1	113.5%
Long-Term Debt	$0.2	$0.6	$ 0.6	$ 0.4	$ 1.3	58.3%
Shareholders' Equity	$2.0	$6.7	$ 37.7	$ 45.6	$ 50.3	124.9%
After-Tax Return on Average Equity (%)	N/M	(55.1%)	8.1%	14.7%	3.8%	
OPERATING PERFORMANCE						
Revenue	$0.0	$2.5	$ 16.1	$ 48.3	$ 56.1	627.6%
U.S. Revenue	$0.0	$2.0	$ 12.7	$ 45.8	$ 43.7	583.7%
Non-U.S. Revenue	$0.0	$0.5	$ 3.4	$ 2.5	$ 12.3	N/M
Cost of Goods Sold	$0.0	$1.0	$ 5.8	$ 16.2	$ 17.6	N/M
Gross Margin	$0.0	$1.5	$ 10.3	$ 32.1	$ 38.5	562.3%
Expenses	$0.8	$4.2	$ 8.9	$ 23.8	$ 36.9	161.5%
R&D Expense	$0.4	$1.7	$ 2.0	$ 5.3	$ 8.6	115.2%
SG&A Expense	$0.4	$2.5	$ 6.9	$ 18.5	$ 28.4	192.0%
N/M						
Operating Income	($0.8)	($2.7)	$ 1.4	$ 8.4	$ 1.6	N/M
Interest Expense	($0.0)	($0.1)	($ 0.1)	($ 0.1)	($ 0.5)	155.0%
Interest Income	$0.3	$0.3	$ 0.9	$ 2.1	$ 1.1	43.7%
Other Income (Expense)					($ 0.4)	N/M
Income before Tax	($0.5)	($2.4)	$ 2.2	$ 10.4	$ 1.8	N/M
NOTE: Pretax Margin	(2,605%)	(97%)	(13%)	(21%)	(3%)	
Taxes	$0.0	$0.0	$ 1.3	$ 4.3	$ 0.3	N/M
NOTE: Effective Tax Rate	0%	0%	60%	41%	15%	
Extraordinary Credit			$ 1.0	$ 0.2	$ 0.3	
Net Income after Tax	($0.5)	($2.4)	$ 1.9	$ 6.3	$ 1.8	N/M
SHAREHOLDER DATA						
Average Shares Outstanding (Millions)	2.5	2.7	10.9	13.6	13.7	53.1%
Per Share Data						
Earnings	$0.0	$0.5	$ 0.2	$ 0.5	$ 0.1	N/M
Dividend	$0.0	$0.0	$ 0.0	$ 0.0	$ 0.0	N/M
Book Value	$0.8	$2.5	$ 3.6	$ 3.3	$ 3.7	46.9%
Price Range (Low) (High)	N/A	N/A	$11 3/4- 12	$ 9 7/8- 17 5/8	$ 6- 10 3/4	
Total Employees	N/A	72	176	435	424	N/M
Revenue Per Employee	N/M	$0.0	$ 0.1	N/M	$ 0.1	N/M

N/M = Not Meaningful
N/A = Not Available

Source: Valid Logic Systems

BACKGROUND

Founded

Valid Logic Systems Incorporated (Valid) was founded in January 1981 by Dr. Jared Anderson, Dr. L. Curtis Widdoes, Dr. Thomas M. McWilliams, Jeffrey Rubin, and Ray C. King.

Positioning

Valid designs, manufactures, markets, and services design automation products for electronic industries. Its application focus spans all ECAD segments, including EDA, IC, and PCB. The Company manufactures proprietary workstations and also sells IBM and Digital Equipment Corporation computers on an OEM basis. Dataquest classifies Valid as an end-to-end ECAD vendor that supports all phases of design.

Valid shipped 990 workstations in 1985 and has an installed base of 2,288 workstations.

FINANCIAL

In 1981, Valid received $2.5 million in the first round of venture financing from Advanced Technology Ventures (ATV), Menlo Ventures, Sequoia, and Intervest. The second round of financing, in 1982, provided the Company with $7.2 million from ATV, Menlo Ventures, Sequoia, Intervest, and Merrill Lynch. An initial public offering, underwritten by Hambrecht and Quist and Merrill Lynch Venture Capital in 1983, yielded $31 million.

HIGHLIGHTS

Listed below in reverse chronological order are recent Company highlights:

- June 1986—Valid added a VAXstation II-based standalone workstation to its product line. The system runs Valid's Entry, Logic, or Validation Designer software under Digital's VMS operating system. Through Ethernet links, the workstation can access files from other Valid systems and Realchip or Realmodel application-specific hardware.

- June 1986—The Company announced that Fujitsu's gate array design software will be available free to qualified users of Validation Designer EDA software. Dataquest believes that this announcement is preliminary to a gate array place-and-route offering for SCALDstar workstations, which will be announced soon. SCALDstar workstations currently support the design of full-custom ICs.

- June 1986—Valid announced the SCALDsystem ST, a two-user system that operates quietly in an office environment. The system is otherwise similar to Valid's SCALDsystem 20.

- June 1986—The Company made Analog Designer software available on its IBM PC AT-based system.

- June 1986—Valid announced the VG, a proprietary, 15-inch, 1,024 x 800 pixel resolution display for its PC AT line.

- March 1986—Valid announced Networked Realchip, which allows multiple users access to the Realchip hardware modeling system.

- March 1986—The Company announced that its Validation Designer system is available on the IBM PC platform.

- February 1986—Valid signed a value-added dealer (VAD) agreement with IBM to use the PC AT in its product line.

- February 1986—Valid added a low-end workstation based on the PC AT with enhanced color display and adapter. The model name depends on the software used.

- December 1985—The Company signed an OEM agreement with Digital Equipment for the MicroVAX II.

- September 1985—Valid introduced the Board Designer, a printed circuit board layout system based on Digital Equipment's MicroVAX II and the SCALDsystem workstation. The Board Designer software is licensed by SECMAI of France.

- August 1985—The Company introduced ValidTIME and ValidSIM, design validation tools.

- August 1985—Valid introduced the Logic Designer AT/G and AT/GX, its first products to use a PC platform. The system uses a 3270 PC AT with either the G or GX color display.

- August 1985—The Company enhanced its product line with the 32-bit 68020-based CPU for higher-speed performance and made retrofit kits available for installed systems.

- August 1985—The Company introduced the Analog Designer, an internally developed analog-design software package that runs on the SCALDsystem 20.

- June 1985—Valid announced Realmodel, application-specific hardware that couples hardware modeling with simulation acceleration to support system-level designs.

- February 1985—The Company signed an agreement with Thomson CSF of France to manufacture Valid's products in Europe.

- 1985—Valid constructed a facility in Diest, Belgium, to provide technical support in Europe.

ORGANIZATION

Personnel Distribution

As of May 1, 1986, the Company's 426 employees were distributed among seven departments (see Table 1).

Table 1

Valid Logic Systems Incorporated
Employees by Department

Department	No. of Employees
R&D/Engineering	75
Marketing/Factory Applications Engineering	49
Manufacturing	66
Domestic Sales/Field Applications Engineering	73
Valid International	86
Field Service	42
Administration	35
Total	426

Source: Dataquest
May 1986

Facilities

The Company operates out of 130,000 square feet at its San Jose, California, headquarters.

MARKETING AND SALES

Strategy

One of Valid's key strategies has been to support industry standards. Examples of this support include the following:

- Valid's software runs on UNIX in a workstation environment and on the VM and VMS host computer operating systems from IBM and Digital Equipment.
- Valid's products can be linked to an Ethernet local area network.
- Valid's software is written in both C and Pascal to simplify porting to new platforms.
- An open-system architecture facilitates Valid's alliances with third-party software vendors.

During the past year, Valid has introduced key IBM PC-based products that can share resources with networked Valid design products. Dataquest expects the Company to make more design functions available to the PC-based systems.

Distribution

Valid distributes its products directly to end users in the United States and both directly and through distributors in other countries.

Locations of U.S. Sales Offices

- Pheonix, Arizona
- Irvine, California
- San Diego, California
- Santa Clara, California
- Orlando, Florida
- Itasca, Illinois
- Greenbelt, Maryland
- Lexington, Massachusetts
- Bloomington, Minnesota
- Cranford, New Jersey
- Cary, North Carolina
- Wayne, Pennsylvania
- Austin, Texas
- Dallas, Texas
- Bellevue, Washington

Locations of Non-U.S. Direct Sales Operations

- Diest, Belgium
- Ontario, Canada
- Slough Berkshire, England
- Cedex, France
- Munich, West Germany

Locations of Non-U.S. Representatives and Distributors

- New South Wales, Australia
- Milan, Italy
- Tokyo, Japan
- Sundbyberg, Sweden
- Wallisellen, Switzerland

SALES SUPPORT

Warranties

Valid warrants its products for 90 days from date of installation. Systems installed in Europe and Japan generally are warranted for one year.

Maintenance Agreements

On-site service contracts include parts and labor cost. Maintenance is 1 percent of the initial purchase price per month for one system, with discounting available for larger installations.

Training

Training courses range from beginning to advanced levels and are offered on a regular basis at San Jose, California, and Lexington, Massachusetts. On-site courses are also available. An on-site installation and training program for IBM PC AT buyers is offered at a lower cost.

Applications Support

The Company maintains a toll free "hot-line" number.

STRATEGIC ALLIANCES

Joint Developments

In 1984, Valid and Seattle Silicon Technology (SST) jointly integrated SST's Concorde silicon compiler with the Valid SCALDstar IC design system. Valid sells Concorde as part of its Silicon Designer software.

Also in 1984, Valid and Teradyne together ported the Teradyne Lasar-6 simulation system onto Valid's SCALDsystems, creating a link between design and automatic test equipment functions. The two companies also succeeded in making Valid's Realchip hardware models available to the Lasar-6 simulator, thus extending fault simulation and test generation to systems containing complex VLSI components.

Valid and Siemens of Germany signed a technology exchange agreement in 1984. In a recent agreement, Siemens will install Valid's SCALD Graphics Editor on Siemens' engineering workstations.

Manufacturing Agreements

In 1985, Valid signed an agreement with the French company Thomson CSF whereby Thomson will manufacture Valid products for the European market.

Marketing Agreements

In 1985, Valid signed value-added-dealer agreements with IBM to market IBM's PC AT as an ECAD workstation.

Valid licenses a portion of the Board Designer software from the French firm SECMAI. This portion, known as ValidROUTE, is sold through an agreement with SECMAI's U.S. distributor, Optima Technology Inc.

OEM Agreements

In 1985, Valid signed an OEM agreement with Digital Equipment for the MicroVAX II.

MAJOR HISTORICAL MILESTONES

Listed below in reverse chronological order are the events that have shaped the Company's past in the CAD/CAM industry:

- September 1984—The Company introduced Concorde, a SCALDstar- based silicon compiler.
- 1984—The Company introduced Realchip, a hardware modeling system, and Realfast, a simulation accelerator.
- 1984—Valid signed an agreement with Teradyne to port the Lasar-6 Fault Simulator to the Valid SCALDsystem, creating a link between the design data base and test program development for ATE systems.
- October 1983—The Company's common stock began trading on the NASDAQ over-the-counter market on October 4, 1983.
- September 1983—SCALDstar, a full-custom IC design workstation compatible with SCALDsystem, was available commercially.
- 1983—The Company received $31 million from an initial public offering.
- May 1982—The first SCALDsystem was shipped.

CAD/CAM PRODUCTS

Market Segment Participation

Valid markets both turnkey and unbundled ECAD products for IC and PCB electronic design automation applications.

Product Line

The Company's products are shown in Table 2.

When sold on a turnkey basis, Valid's workstation-based products consist of a 32-bit microprocessor, high-resolution graphics display, graphics tablet and keyboard, software modules, and device libraries. The Company's major platforms are its proprietary line of Motorola 68020-based workstations, Digital Equipment's MicroVAX II and VAXstation II, and IBM's PC AT products. Valid's software also operates on IBM and Digital host computers. The Company's products are based on the UNIX operating system, Ethernet local area network, and C and Pascal languages.

Table 2

Valid Logic Systems Incorporated
Products

HARDWARE PLATFORMS:

Model	Product
SCALDsystem 20	Design system consisting of Valid's S-320 computer and up to 4 workstations; based on the Motorola 68020 32-bit microprocessor; provides up to 12MB of RAM, 16MB of virtual memory, and 2GB of disk storage
SCALDsystem	Two-user system similar to SCALDsystem 20 that operates quietly in an office environment
SCALDstar	Dedicated S-320 full-custom IC design system; dual screens permit a designer to simultaneously view both a logic design and the corresponding physical layout
IBM PC-based Workstation	To an IBM PC AT, Valid adds a 32-bit coprocessor running UNIX, 2MB RAM, 16MB virtual memory, and an 85MB hard disk; resulting workstation can access a SCALDsystem host or application-specific hardware on a network; options for IBM PC display are: — GX (1,024 x 1,024 pixels, 19-inch screen) — EG (640 x 350 pixels, 13-inch screen) — VG (1,024 x 800 pixels, 15-inch screen)
Digital MicroVAX II	Valid combines the MicroVAX II with a SCALDsystem workstation; this system is used with Board Designer software
Digital VAXstation II	Workstation that runs Entry, Logic, or Validation Designer software and can connect directly to Realchip or Realmodel

APPLICATION-SPECIFIC HARDWARE (available to networked workstations):

Model	Product
Realchip	Modeling system that allows a user to substitute a real IC device, such as a 68020, in place of a software model of that device; Realchip provides a library of standard IC components that can be incorporated into design simulation; users can also create models for custom ICs
Realfast	Simulation accelerator that provides interactive simulation of designs containing up to 3 million gates
Realmodel	System combining Realchip hardware modeling with Realfast simulation acceleration
Networked Realchip	Multiuser Realchip directly connected to Ethernet; an enhancement to the above application-specific hardware, which can be accessed by only one user at a time on a network

(Continued)

Table 2 (Continued)

Valid Logic Systems Incorporated
Products

***APPLICATION SOFTWARE:**

Model	Function
Entry Designer	Schematic capture
Logic Designer	Schematic capture with netlist generation
Validation Designer	Schematic capture, netlist generation, logic simulation, and timing verification
Analog Designer	Analog schematic design, analysis, and netlist generation; tools include software-generated oscilloscope, digital voltmeter, function generator, and network analyzer; available for SCALDsystem 20 and PC AT
IC Designer	Layout and analysis tools for custom ICs using SCALDstar; supports Validation Designer software
Silicon Designer	IC Designer functions plus silicon compilation using SCALDstar
Board Designer	PCB layout system that runs on a MicroVAX II; available to networked SCALDsystem workstations

*Valid names workstations according to the applications software used; for example, a workstation with the Validation Designer software would be referred to as a Validation Designer, regardless of the hardware platform used.

Source: Valid Logic Systems
Dataquest
July 1986

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Valid Logic Systems Incorporated

Valid Logic Systems Incorporated
650 North Mary Avenue
Sunnyvale, California 94086
Telephone: (408) 773-1300 TWX: 910-339-9618
(Millions of Dollars Except Per Share Data)

Balance Sheet (December 31)

	1981*	1982	1983**
Working Capital	$ 1.78	$6.02	$5.90
Long-Term Debt	$ 0.21	$0.57	$0.62
Shareholders' Equity	$ 1.96	$6.73	$7.04
After-Tax Return on Average Equity (%)	N/M	N/M	N/M

Operating Performance (Fiscal Year Ending December 31)

	1981	1982	1983
Revenue	$ 0.02	$ 2.47	$ 5.20
U.S. Revenue*	$	$ 1.95	$ N/A
Non-U.S. Revenue*	$	$ 0.52	$ N/A
Cost of Revenue	$ -	$ 1.00	$ 1.75
R&D Expense	$ 0.40	$ 1.65	$ 0.84
SG&A Expense	$ 0.39	$ 2.50	$ 2.46
Pretax Income (Loss)	$(0.53)	$(2.39)	$ 0.28
Pretax Margin (%)	N/A	N/A	5.4
Effective Tax Rate (%)	N/A	N/A	N/M
Net Income	$(0.53)	$(2.39)	$ 0.25#
Average Shares Outstanding (Millions)	2.5	2.7	9.8
Per Share			
Earnings (Loss)	$ 0.00	$ 0.51	$ 0.03#
Dividend	$ 0.00	$ 0.00	$ 0.00
Book Value	$	$	$ 0.71
Price Range	$ N/A	$ N/A	$11 3/4-12
Total Employees	N/A	N/A	108

N/A = Not Available
N/M = Not Meaningful
*Period began April 17, 1981
**First six months ended June 30
#Includes extraordinary item from net operating loss carry forward

Source: Valid Logic Systems Incorporated Prospectus
DATAQUEST

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Valid Logic Systems Incorporated

BACKGROUND

The Company

Valid Logic Systems Incorporated was founded in January 1981 by Dr. Jared A. Anderson, Dr. L. Curtis Widdoes, Jr., Mr. Ray C. King, Dr. Thomas M. McWilliams, and Mr. Jeffrey B. Rubin. The Company designs, manufactures, markets, and services computer-aided engineering workstations for the electronics industry.

Valid was one of the first companies to provide commercially what DATAQUEST has designated an Electronic Design Automation (EDA) system specifically for use by electronic engineers in designing integrated circuits and electronic systems.

The Company's common stock began trading on the NASDAQ Over-the-Counter market on October 4, 1983.

Operations

Valid's workstation-based EDA products are sold on a turnkey basis and consist of a microcomputer, high-resolution graphics display, graphics tablet and keyboard, software modules, and device libraries. The Company's three major products are called SCALDsystem, SCALDsystem II, and SCALDstar.

The first SCALDsystem was shipped to a Beta test site in May 1982. Volume shipments commenced at the end of the second quarter of 1982. The SCALDsystem II, which operates as a standalone workstation or in conjunction with a host computer, was introduced in June 1983. The SCALDstar, also introduced in June 1983, is a dual-display design workstation compatible with the SCALDsystem. SCALDstar became commercially available in September 1983.

Total revenue for Valid Logic Systems in fiscal 1982 was $2.48 million. Of this amount, approximately $1.95 million was derived in the United States, and $0.52 million was derived principally in the Far East. For the six months ended June 30, 1983, Valid reported revenue of $5.21 million, of which approximately $4.67 was derived in the United States and approximately $0.54 million was derived principally in Western Europe.

Marketing

Valid sells most of its EDA systems through its direct sales force. The Company currently operates seven technical centers, six in the United States and one in Europe, which are used as sales offices and customer service centers. Valid plans to open additional technical centers in the United States and Europe during the balance of 1983. The Company employs distributors or manufacturers' representatives in Japan (where Mitsubishi Corporation is the Company's exclusive sales agent) and in 10 locations in the United States and Europe.

Valid employs technically experienced sales personnel, systems engineers, and field engineers at its technical centers. In addition, the Company also employs applications engineers for marketing support and documentation.

The Company has targeted accounts within the electronic systems market, including the computer, communications, military, aerospace, instrumentation, and consumer segments of that market. Valid plans to expand its SCALDstar system marketing effort to include LSI and VLSI manufacturers.

In 1982, Valid's biggest customers were Digital Equipment Corporation, which accounted for 29 percent of revenues; Mitsubishi, which accounted for 20 percent; and Norden Systems, a subsidiary of United Technologies Corporation, which accounted for 11 pecent. In the first six months of 1983, Digital Equipment Corporation accounted for 21 percent of the Company's revenues; no other customer accounts for 10 percent or more of the Company's revenues.

Research and Development

In fiscal 1982, Valid spent approximately $1.5 million on product development. During the first six months of fiscal 1983, the Company spent approximately $865,000. The Company's product development strategy is principally focused on implementing an enhanced operating system, expanding device libraries, and developing advanced products. Valid makes extensive use of its SCALDsystem in its development efforts.

Approximately 30 engineering professionals are engaged in product development. Five of these engineers are engaged exclusively in device library development.

Valid Logic Systems Incorporated

Manufacturing

The Company designs and manufactures its own workstations. Operations for manufacturing consist of assembly, test, and quality assurance of its parts, subassemblies, and systems.

The Company uses standard parts and components, which are pretested and burned-in in its products. The Company leases a major portion of the machinery and equipment used in its operations.

The Company's main headquarters and manufacturing facility is presently located in a 20,000-square-foot building in Sunnyvale, California, under lease for a term ending in 1985. The Company plans to move its main operations to a 64,000-square-foot facility before the end of 1983. The Company also leases additional offices for its direct sales operations.

Organizaton

As of June 30, 1983, Valid employed 108 persons, including 38 in marketing and sales; 26 in research, development, and related engineering activities; 10 in customer engineering; 23 in manufacturing; and 11 in executive and administrative activities.

CAD/CAM BUSINESS

Valid has structured its software products around hardware systems based on a proprietary central processing system that incorporates the Motorola M68000 microprocessor. The workstation products utilize the UNIX operating system. The Company makes available a number of utility programs based on UNIX software, incuding language compilers for the C, Pascal, and FORTRAN languages. The Company's design validation programs are unique in that they run on both Valid's workstations and on the Digital Equipment VAX or IBM/370-compatible host computers. All Valid's workstation products can communicate with one another and with these host computers over the Ethernet high-speed local area network.

Hardware Systems

The Company offers modular turnkey workstation-based systems for the entry, analysis, and revision of architecture and logic design of all types of electronic systems and integrated circuits. Valid's workstations include hardware developed and manufactured by the Company and SCALD (Structured Computer-Aided Logic Design) software programs. The price per station, including workstation software, varies from $30,000 to $80,000 depending on configuration.

SCALDsystem I consists of one to four microprocessor-based workstations that share central resources, including disk and tape drives, plotter, main memory, communications facilities, and power supply.

SCALDsystem II uses substantially the same hardware as SCALDsystem I, but is packaged as a single-station unit whose elements are contained within the workstation table and display base. SCALDsystem II does not support additional workstations.

SCALDstar is a dual-screen standalone workstation that includes a monochrome display for logic design and a color display for layout.

SCALDsystem I and SCALDsystem II address product definition, logic design, and validation portions of the electronic system and circuits development cycle. SCALDstar, announced in June 1983, incorporates the same functions as SCALDsystem I and SCALDsystem II, but also includes physical design capabilities.

Design and Validation Software

SCALD permits hierarchical design and separation of logic and timing verification. The Company offers the following SCALD-based integrated design and validation programs that support structured design of electronic systems:

- The SCALD Graphics Editor is used for the entry and revision of schematic diagrams representing logic designs. The Graphics Editor supports continuous scaling and rerouting.

- The SCALD Compiler analyzes the structured, hierarchical logic designs entered using the Graphics Editor, and transforms them into expanded forms for use by other Valid analysis tools.

- The SCALD Timing Verifier analyzes electronic designs for timing problems in logic elements and their interconnections. The SCALD Timing Verifier was invented by one of the Company's founders.

- The SCALD Logic Simulator allows creation of a design in software to determine accurate logical functioning. The Company offers its own version of the SPICE 2G.5 program for circuit simulation.

- The SCALD Post Processor transfers completed logic designs to other systems for further verification, test generation, or physical design. The SCALD Post Processor supports a wide range of logical and physical interfaces.

The Company has announced that it intends to supply a full set of topological design and analysis software for full-custom VLSI layout using any of the currently available semiconductor processing technologies, including PMOS, NMOS, CMOS, bipolar (including ECL and TTL), and gallium arsenide. Valid recently announced hierarchical analysis programs for use in VLSI layout to check for electrical rule violations or process-specific design-rule violations. The Company plans to have these programs available by the end of 1983.

Device Libraries

Device libraries contain the graphical shapes, pin-out description, simulation model, and timing model for components in a logic family.

The Company has developed and provides high-quality device libraries for a number of popular standard-component logic families including TTL, Schottky TTL, LSTTC, ECL 10K, ECL 100K, FAST, 5400 (military), and MOS memories. The Company is working to provide fully qualified, comprehensive libraries for many of the gate-array and standard-cell product lines.

Applications

Applications of SCALDsystems include design of customer very large scale integrated (VLSI) circuits; semicustom logic circuits, such as gate arrays or standard cells; and electronic systems that consist of numerous integrated circuits.

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VTI

VLSI Technology Incorporated

VLSI Technology Incorporated
1101 McKay Drive
San Jose, California 95131
Telephone: (408) 942-1810 Telex: 278807
(Thousands of Dollars Except Per Share Data)

CORPORATE FINANCIAL PROFILE AS OF DECEMBER 25

	1980	1981	1982	1983	CAGR 1980-1983
BALANCE SHEET DATA					
Working Capital	$ 1,967	$ 8,155	$ 6,887	$ 38,946	170.5%
Long-Term Debt	N/A	$ 318	$ 10,783	$ 15,822	
Shareholders' Equity	$ 9,983	$ 8,524	$ 8,458	$ 54,722	76.3%
After-Tax Return on Average Equity	N/A	0.02%	0.05%	0.05%	
OPERATING PERFORMANCE					
Revenue	$ 82	$ 553	$ 21,229	$ 35,830	658.8%
Expenses	$ 106	$ 2,178	$ 23,620	$ 44,601	649.3%
Cost of Revenue	$ 74	$ 140	$ 17,000	$ 29,888	639.2%
R&D Expense	0	$ 809	$ 3,320	$ 8,470	N/M
SG&A Expense	$ 32	$ 1,229	$ 3,300	$ 6,243	480.0%
Operating Income	($ 24)	($ 1,625)	($ 2,391)	($ 8,771)	N/M
Interest Income, Net	$ 2	$ 147	$ 301	$ 2,088	914.5%
Income Before Tax	($ 22)	($ 1,478)	($ 2,090)	($ 6,683)	N/M
NOTE: Pretax Margin	(26.8%)	(267.3%)	(9.8%)	(18.7%)	N/M
Taxes	0	0	0	0	N/M
NOTE: Effective Tax Rate	N/M	N/M	N/M	N/M	N/M
Net Income after Tax	($ 22.0)	($ 1,478)	($ 2,090)	($ 6,683)	N/M
SHAREHOLDER DATA					
Average Shares Outstanding (Thousands)	1.0	2.1	4.0	14.3	
Per Share Data					
Earnings	($ 0.01)	($ 0.72)	($ 0.53)	($ 0.47)	
Dividends	0	0	0	0	
Book Value	$6,239.4	$4,059.1	$2,114.5	$3,826.7	
Price Range (Low)	N/A	N/A	N/A	$ 9-	
(High)				23	
TOTAL EMPLOYEES	N/A	N/A	193	405	

N/A = Not Available
N/M = Not Meaningful

Source: VLSI Technology Incorporated Annual Reports & Forms 10K

VLSI Technology Incorporated
1101 McKay Drive
San Jose, California 95131
Telephone: (408) 942-1810 Telex: 278807

LINE ITEMS AS A PERCENT OF REVENUE

	1980	1981	1982	1983
OPERATING PERFORMANCE				
Revenue	100.0%	100.0%	100.0%	100.0%
Expenses	129.3%	393.9%	111.3%	124.5%
Cost of Revenue	90.2%	25.3%	80.1%	83.4%
R&D Expense	0.0%	146.3%	15.6%	23.6%
SG&A Expense	39.0%	222.2%	15.5%	17.4%
Operating Income	(29.3%)	(293.9%)	(11.3%)	(24.5%)
Interest Income	2.4%	26.6%	1.4%	5.8%
Income before Tax	(26.8%)	(267.3%)	(9.8%)	(18.7%)
Taxes	0.0%	0.0%	0.0%	0.0%
Net Income after Tax	(26.8%)	(267.3%)	(9.8%)	(18.7%)

Source: DATAQUEST

VLSI Technology Incorporated

THE COMPANY

Background

VLSI Technology, Incorporated, (VTI) was incorporated in California on August 1, 1979. It had its first public stock offering in February 1983. VTI develops and markets products and services for the design and manufacture of application-specific integrated circuits (ASICs). Using its design tools and internal design group, the Company also manufactures and markets proprietary application-specific IC designs.

Highlights

In January 1984, Wang Laboratories acquired 15 percent ownership of VTI through a stock purchase. We believe that this investment in VTI will strengthen the cooperation between the two companies in developing and manufacturing advanced VLSI circuits for Wang's office automation equipment. The investment reflects and strengthens VTI's position in the computer markets.

In May 1984, VTI and Fairchild Camera and Instrument Corporation announced a co-development and alternate source agreement for Fairchild's 2-micron CMOS gate arrays. The agreement includes provisions for joint product specification and development, product and software exchanges, and process cooperation, and puts VTI in the gate array segment of the ASIC market.

VTI extended its relationship with Ing. C. Olivetti & Co., S.p.A., to fund further research on advanced design technologies and to establish a joint design center in Italy.

Operations

VTI's strategy is to reduce the time from order to delivery of ASICs. It offers electronic systems manufacturers the methodology and tools to design circuits quickly and economically, and the fabrication facilities for quick turnaround of prototype or volume production circuits.

The Company is shifting its emphasis from consumer products to commercial computer products. In 1982, VTI derived 81 percent of its revenues, primarily from sales of ROMs used in home video cartridges. During fiscal 1983, the Company increased revenues for high-speed, high-density ROMs for computer applications, while ROMs for consumer home video cartridges declined as a percent of total revenue.

VLSI Technology Incorporated

VTI's design tools are the cornerstone of its strategies for the ASIC market. The Company has developed a set of proprietary tools that it will license to customers or use in its design centers for automated cell or array designs. Revenues from software design tools and engineering services were $7.5 million in 1983, compared to $3.2 million in 1982.

VTI's 1983 revenues increased 69 percent to $35.8 million from $21.2 million in 1982. The Company had a net loss in 1983 of $6.7 million and a net loss in 1982 of $2.1 million. In the first two quarters of 1984, however, the Company showed increases in both revenues and net income, as indicated in Table 1.

The Company had a more diverse customer base in fiscal 1983 than in 1982. Three customers accounted for 32, 11, and 11 percent of revenues in 1983, compared to two customers with 52 and 17 percent of 1982 revenues.

Table 1

VLSI Technology Incorporated
SIX MONTHS 1984 RESULTS
(Millions of Dollars)

	Quarter 1	Quarter 2
Revenue	$14.257	$17.582
Net Income	$ 1.303	$ 2.005

Source: VLSI Technology, Incorporated

Marketing

The market for electronic systems is increasing the demand for higher-performance, lower-cost, more complex circuitry. The focus is shifting away from standard, off-the-shelf products. As circuit design technology advances, VTI believes that electronic systems manufacturers will seek to control the design process and design their own systems-level circuits. VTI's marketing strategy is to meet the needs of electronic systems manufacturers by providing a range of products, design services, and fabrication facilities.

VLSI Technology Incorporated

The Company has seven sales offices located in San Jose and Irvine, California; Dallas, Texas; Boston, Massachusetts; Hartford, Connecticut; Atlanta, Georgia; and Rolling Meadows, Illinois. VTI sells its products and services through a direct salesforce.

Research and Development

VTI's R&D expenditures increased dramatically in 1983, to $8.5 million or 24 percent of revenues, from $3.3 million or 16 percent of 1982 revenues. This represents a 155 percent increase. The major focus on 1983 R&D activities was an HCMOS process technology and advances in the design automation tools.

VTI decreased its dependence on outside IC manufacturers during 1983; only 10 percent of manufacturing revenues were produced internally in the first quarter, but 90 percent of manufacturing revenues were produced internally in the fourth quarter.

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